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NASA/SP—1999–7037/SUPPL395
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Typical Report Citation and Abstract

1. 19970001126 NASA Langley Research Center, Hampton, VA USA
2. Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes
3. Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA.
4. Mar. 1996, 138p. In English
5. Contract(s)/Grant(s): RTOP 505-68-70-04
6. Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright. Avail: CASI, A07, Hardcopy; A02, Microfiche
7. To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10° to 50°, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65° swept forebody serrations tended to roll together, while vortices from 40° swept serrations were more effective in generating additional lift caused by their more independent nature.
8. Author
9. *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

Key

1. Document ID Number; Corporate Source
2. Title
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AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 395)

MARCH 5, 1999

01
AERONAUTICS

19990017872 NASA Scientific and Technical Information Facility, Baltimore-Washington International Airport, MD USA
Aeronautical Engineering: A Continuing Bibliography With Indexes, Supplement 392
Jan. 22, 1999; 89p; In English
Report No.(s): NASA/SP-1999-7037/SUPPL392; NAS 1.21:7037/SUPPL392; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report lists reports, articles and other documents recently announced in the NASA STI Database. The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.
Derived from text
Aeronautical Engineering; Aerodynamics; Aircraft Engines

19990018232 Research and Technology Organization, Neuilly-sur-Seine, France
Fluid Dynamics Research on Supersonic Aircraft / Les Travaux de Recherche en Dynamique des Fluides Relatifs aux Aeronefs Supersoniques
Fluid Dynamics Research on Supersonic Aircraft; Nov. 1998; 332p; In English, 25-29 May 1998, Rhode-Saint-Genese, Belgium; Also announced as 19990018233 through 19990018251
Report No.(s): RTO-EN-4; AC/323(AVT)TP/6; ISBN 92-837-1007-X; Copyright Waived; Avail: CASI; A15, Hardcopy; A03, Microfiche

This report Contains the lecture notes prepared for a Special Course on 'Fluid Dynamics Research on Supersonic Aircraft' organized by the Research and Technology Organization (RTO) Applied Vehicle Technology Panel (AVT). The Course was held at the von Karman Institute for Fluid Dynamics (VKI) Institute, Rhode-Saint-Genese, Belgium 25-29 May 1998. The following topics were covered: History and Economics of Supersonic Transports, Supersonic Aerodynamics, Sonic Boom Theory and Minimization, Multi-Point Design Challenges, Vortex Plume Interactions, Propulsion System Design. Presentations on the major world wide supersonic transport programs were also included. The material assembled in this publication was prepared under the combined sponsorship of the RTO Applied Vehicle Technology Panel, the Consultant and Exchange Program of RTO, and the von Kdrmdn Institute (VKI) for Fluid Dynamics.
Author
Research Aircraft; Supersonic Transports; Computational Fluid Dynamics; Conferences

19990018443 NASA Langley Research Center, Hampton,VA USA
Aeronautical Engineering: A Continuing Bibliography with Indexes
Feb. 05, 1999; 58p; In English
Report No.(s): NASA/SP-1999-7037/SUPPL393; NAS 1.21:7037/SUPPL393; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This supplemental issue of Aeronautical Engineering: A Continuing Bibliography with Indexes lists reports, articles, and other documents recently announced in the NASA STI Database. The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles. Each entry in the publication consists of a standard bibliographic citation

accompanied, in most cases, by an abstract. The NASA CASI price code table, addresses of organizations, and document availability information are included before the abstract section. Two indexes-subject and author are included after the abstract section.
Derived from text
Bibliographies; Aeronautical Engineering

02
AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces, and internal flow in ducts and turbomachinery.

19980017801 Research and Technology Organization, Applied Vehicle Technology Panel, Neuilly-sur-Seine, France
Missile Aerodynamics *Aerodynamique des Missiles*
Nov. 1998; 526p; In English, In French, 11-14 May 1998, Sorrento, Italy; Also announced as 19980017802 through 19980017840; Original contains color illustrations
Report No.(s): RTO-MP-5; AC/323(AVT)TP/3; ISBN 92-837-0002-3; Copyright Waived; Avail: CASI; A22, Hardcopy; A04, Microfiche

This report contains the papers prepared for the Symposium on 'Missile Aerodynamics' organised by the RTO Applied Vehicle Technology Panel (AVT), which was held 11-14 May 1998 in Sorrento, Italy. In addition, a Technical Evaluation Report aimed at assessing the success of the Symposium in meeting its objectives, and an edited transcript of the General Discussion held at the end of the Symposium are also included. This Symposium was dedicated to the memory of Dr. Jack Nielsen and a keynote paper addressed his contributions to Missile Aerodynamics. An additional keynote paper was presented on Future Missile System Trends and their Impact on Aerodynamics. In addition to the keynote presentations, 38 Papers were presented during sessions on the following subjects: Aerodynamic Design, Unconventional Configurations, Jet Effects, Flows Physics and Turbulence Modeling, and Prediction Methodology.
Author
Missiles; Missile Configurations; Aerodynamics; Missile Design; Jet Flow; Aerodynamic Characteristics

19980017802 Army Missile Research, Development and Engineering Lab., Redstone Arsenal, AL USA
Future Missile System Trends (US) and Their Impact on Aerodynamic Technology
McCorkle, William C., Jr., Army Missile Research, Development and Engineering Lab., USA; Missile Aerodynamics; Nov. 1998; 16p; In English; Also announced as 19980017801; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents a prognosis of missile design trends within the USA for the next decade. The views are those as perceived by the author and do not constitute an official position of the Department of Defense or any of its branches of service. It is based primarily on open literature briefings and Internet information combined with the experiences of the author acquired in rocket and missile design over the past forty years (at the US Army Aviation and Missile Command and its predecessor organizations). Expected trends in missile design and their resulting airframe requirements are interpreted in terms of advancements in aerodynamic technology, which greatly enhance the probabilities of successfully meeting overall system performance goals.
Author
Missiles; Missile Configurations; Aerodynamics; Missile Design; Missile Systems

19980017803 Aerospatiale Missiles, Chatillon, France
Considerations on Aerodynamics for Piloting and Guidance of Tactical Devices *Considerations sur l'Aerodynamique pour le Pilotage et le Guidage des Engins Tactiques*
Harcaut, Jean-Phillipe, Aerospatiale Missiles, France; Larcher, Eric, Aerospatiale Missiles, France; Bonnet, Jean-Paul, Aerospatiale Missiles, France; Dupont, Stephane, Aerospatiale Missiles, France; Nov. 1998; 12p; In French; Also announced as 19980017801; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This article reviews existing relations between piloting/guidance and the external aerodynamics of a cell, from the preliminary conception phase through flight simulation. The different points covered are as follows: definition of an aerodynamic configuration, numerical simulation aerodynamic model, and major aerodynamic factors for piloting and guidance.
Transl. by Schreiber
Missiles; Aerodynamic Characteristics; Missile Design; Aerodynamic Configurations; Missile Configurations; Missile Control

19990017807 Institut Franco-Allemand de Recherches, Saint-Louis, France

Aerodynamics of Wrap Around Fins Using Experimental and Computational Techniques

Berner, Claude, Institut Franco-Allemand de Recherches, France; Abate, Gregg, Air Force Research Lab., USA; Dupuis, Alain, Defence Research Establishment Valcartier, Canada; Nov. 1998; 26p; In English; Also announced as 19990017801; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents carefully made experiments in wind tunnel and aeroballistic range facilities as well as results of numerical simulations for wrap around fin (WAF) configurations. The experimental program consisted of flow visualization, static pressure, force, and flow velocity measurements made in wind tunnels and of free flight tests made in an instrumented aeroballistic range facility. Flow field predictions were carried out using a fully implicit, combined finite volume/flux elements 3D Navier-Stokes employing a standard k-E model with wall functions. Experimental and CFD results were obtained, depending on the measurements, for nominal Mach numbers in the subsonic, transonic, and supersonic regime and for angles of attack ranging between -15 and 15 degrees and for roll angle positions of 0 and 45 degrees. Results obtained numerically were compared with the free flight and wind tunnel tests. Comparisons of the different aerodynamic coefficients show favorable agreement.

Author

Missiles; Missile Configurations; Aerodynamic Characteristics; Missile Design; Computational Fluid Dynamics; Finite Volume Method; Fins; Wind Tunnel Tests; Navier-Stokes Equation; Flow Visualization

19990017808 Air Force Research Lab., Air Vehicles Directorate, Wright-Patterson AFB, OH USA

Aerodynamics of Wrap-Around Fins at High Supersonic Speeds

Tilmann, Carl P., Air Force Research Lab., USA; McIntyre, Thomas C., Space and Missile Systems Organization, USA; Bowersox, Rodney D. W., Alabama Univ., USA; Buter, Thomas A., Air Force Test Pilot School, USA; Nov. 1998; 18p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Wrap-around fins (WAFS) have been investigated experimentally and numerically at supersonic speeds with the objective of understanding the flowfield in the vicinity of the fin, and its influences on rolling behavior. Experimental techniques used include conventional pressure surveys, cross-wire hot-film anemometry, schlieren and shadowgraph imaging, pressure-sensitive paint, and surface oil-flow visualizations. First, a wall-mounted semi-cylindrical model fitted with a single wrap-around fin was investigated both numerically and experimentally, with the objective of characterizing the mean and turbulent flowfield in the vicinity of the fin. These investigations were conducted at Mach numbers of 2.8 and 4.9, and chord Reynolds numbers 0.37 and 1.52 million, respectively. Results were used to determine the nature of the flowfield, and to quantify the effects of fin curvature on the character of the flow near WAFS. Numerical techniques ranged from inviscid Euler methods to solving the full Navier-Stokes equations with an algebraic eddy viscosity model. Correlation with experimental data suggests that the latter method captured the essential features of this complicated flowfield. Second, experiments were conducted on multiple-finned WAF configurations to investigate the effects of Mach number on rolling moment. Photo-luminescent pressure-sensitive paint techniques were used to obtain surface pressures that were integrated to estimate rolling moments. The Mach numbers ranged from 2.14 to 3.83. Two curved geometry fins were tested; one solid and the other slotted. Results indicate that the flow structure near the WAF is qualitatively invariant over the conditions tested. However, the strength and location of salient features in the flowfield which act on the fin can be significantly influenced by Mach number. ne flowfield is characterized by very strong and complicated inviscid-viscous interactions, which have a large impact on the aerodynamic loading of the fins. In particular, a vortex is generated in the fin/body juncture region on the convex side of the fin. This vortex, not predicted by inviscid methods, can greatly influence the pressure loading on the fin near the root. Changes in this vortex structure may contribute to the rolling moment reversal observed at high supersonic speeds in recent flight test experiments.

Author

Missiles; Missile Configurations; Missile Design; Flow Visualization; Navier-Stokes Equation; Finned Bodies; Missile Components; Rolling Moments; Supersonic Speed; Turbulence; Wind Tunnel Tests; Inviscid Flow; Flight Tests

19990017810 Army Aviation and Missile Command, Redstone Arsenal, AL USA

Experimental Investigations of Grid Fin Aerodynamics: A Synopsis of Nine Wind Tunnel and Three Flight Tests

Washington, William David, Army Aviation and Missile Command, USA; Miller, Mark S., Dynetics, Inc., USA; Nov. 1998; 14p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Wind tunnel and flight tests have been conducted to investigate the aerodynamic characteristics of grid fins and to demonstrate their utility in actual flight hardware and ballistic flight performance. Nine wind tunnel tests have been conducted on 26 different grid fin configurations. Test parameters have included Mach numbers ranging from 0.35 to 3.5 with nominal angles of attack up to 17 degrees. Investigative issues have included: basic aerodynamic coefficients, grid fin curvature for efficient packaging, drag reduction techniques, transonic choke regions, geometric variables (span, chord, height, cell spacing and web thickness), fin

sweep back effects, and grid fin/planar fin comparisons. Two flight tests, with rockets launched out of a circular launch tube, successfully demonstrated the capability to package and stow grid fins within a circular rocket body shape, deploy grid fins during flight, despin, and stabilize the warhead section after stage separation until completion of the mission. An additional air drop flight test was conducted to demonstrate the flight worthiness of a rocket payload section during aft dispense of multiple submunitions.
Author
Missiles; Missile Configurations; Aerodynamics; Aerodynamic Characteristics; Missile Design; Fins; Flight Tests; Wind Tunnel Tests; Ballistics

19990017811 Army Missile Research, Development and Engineering Lab., Redstone Arsenal, AL USA
Aerodynamic Prediction Methodology for Grid Fins
Kretzschmar, Richard W., Army Missile Research, Development and Engineering Lab., USA; Burkhalter, John E., Auburn Univ., USA; Nov. 1998; 12p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Formulation and validation of a theoretical methodology to predict the aerodynamic forces and moments associated with missile configurations utilizing grid fins in subsonic, transonic and supersonic Mach regimes is discussed in detail. Comparisons with experimental data collected on a variety of grid fin configurations are presented to provide an indication of the methodology accuracy. Conclusions regarding the accuracy and limitations of the prediction methodology are drawn from these comparisons.
Author
Missiles; Missile Configurations; Aerodynamics; Missile Design; Aerodynamic Forces; Stability Derivatives; Fins

19990017812 National Research Council of Canada, Inst5. for Aerospace Research, Ottawa, Ontario Canada
Computation of Flows Past Grid Fin Missiles
Khalid, Mahmood, National Research Council of Canada, Canada; Sun, Y., National Research Council of Canada, Canada; Xu, H., National Research Council of Canada, Canada; Nov. 1998; 12p; In English; Also announced as 19990017801; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The paper contains a CFD study of flows past missiles and isolated stores equipped with different types of control surface devices or other attachment equipment used for carriage purposes. Traditionally, missile designers have relied on planar surface control mechanisms, both as wings and/or fins for providing the necessary aerodynamic adjustment for in-flight guidance. It has been found, however, that grid fin type control surfaces may be more advantageous in terms of generating relatively higher normal force coefficients (CN's) and smaller hinge moments. The drag from these grid fin control surface devices tends to be somewhat higher. This feature is not always altogether undesirable, particularly when the intent is to decelerate a missile released from a fast moving aircraft.
Author
Missiles; Missile Configurations; Aerodynamics; Missile Design; Computational Fluid Dynamics; Flow Visualization; Control Surfaces; Fins

19990017813 Air Force Research Lab., Munitions Directorate, Eglin AFB, FL USA
Experiments and Analyses of an Aerospike Flow Environment for Protecting Infrared Missile Dome
Boudreaux, E. J., Air Force Research Lab., USA; Krishnamurty, V. S., Florida Univ., USA; Mitchell, A. M., Air Force Research Lab., USA; Shyy, W., Florida Univ., USA; Nov. 1998; 18p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

In the late 1980s, Air Force Research Laboratory began research in the use of aerospike technology to reduce the heating rate on an infrared dome for a high speed, extended range tactical missile. Results from wind tunnel tests, simulations, and analyses provided a database for modelling the flow field created by an aerospike. The effects of turbulence on the performance of the aerospike arrangements were analyzed in the k-epsilon based modelling framework with emphasis on the influence of factors such as streamline curvature and shock discontinuities.
Author
Missiles; Missile Configurations; Aerodynamics; Missile Design; Domes (Structural Forms); Aerospike Engines; Turbulence Effects; Wind Tunnel Tests

19990017814 Defence Evaluation Research Agency, WX9 Aerophysics, Farnborough, UK
Hypersonic Shroud Discard at High Dynamic Pressure
Cain, T., Defence Evaluation Research Agency, UK; Redman, A., Defence Evaluation Research Agency, UK; Nov. 1998; 4p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A01, Hardcopy; A04, Microfiche

The paper describes analytical techniques for predicting shroud trajectory and experimental techniques for a dynamic study of the initial stages of shroud separation. Dimensional analysis of hypersonic shroud discard at high dynamic pressure is presented. A key feature of the process is the high accelerations due to the high aerodynamic force to weight ratio of practical shrouds. Since Froude number is not critical the experimenter can arrange the discard time to suit his facility. Methods of mass producing small scale model shrouds as well as controlling their release from the core vehicle are described.
Author
Missiles; Missile Configurations; Aerodynamics; Missile Design; Scale Models; Hypersonics; Shrouds; Dynamic Pressure

19990017815 Institut Franco-Allemand de Recherches, Saint-Louis, France
The Near Interaction of Lateral Control Jets and Hypervelocity Cross Flow
Naumann, K. W., Institut Franco-Allemand de Recherches, France; Ende, H., Institut Franco-Allemand de Recherches, France; George, A., Institut Franco-Allemand de Recherches, France; Mathieu, G., Institut Franco-Allemand de Recherches, France; Nov. 1998; 12p; In English. Also announced as 19990017801
Contracts/Grants): BMVG-T/R-760/Y-0001/R-1701; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Experiments on the interaction of gaseous jets blowing laterally into hypervelocity cross-flow are carried out using physical and optical measuring methods in ISL shock tunnel "B". Different models producing 1 to 3 perpendicularly oriented jets of different gases, gas mixtures, and solid propellant are used. The force effect acting on the model is measured directly using the ISL, millisecond aerodynamic force measurement technique. A specially trimmed free-flying model gives sufficient measuring time to allow measurements also on instationary effects during the starting phase of the test flow. The result is that the force effect acting on the model shows reproducible non-stationary behaviour. The visualisation of the jet/cross-flow interaction flowfield is carried out by differential interferometry and illumination by a laser light sheet of particles seeded into the jet flow. The pictures show that single jets in all cases are deflected supersonically by an oblique shock. The space between this internal jet shock and the jet bow shock is filled with large vortices. A detailed quantitative quasistationary description of the flowfield derived from the experiments explains the action and the cause of the essential effects.
Author
Hypervelocity Flow; Lateral Control; Oblique Shock Waves; Blowing; Gas Jets; Jet Control; Jet Flow; Missile Control; Missile Design

19990017816 Office National d'Etudes et de Recherches Aerospatiales, Paris, France
Aerodynamic Interactions on a Hypersonic Interceptor Piloted by Transversal Jets *Interactions Aerodynamiques sur un Intercepteur Hypersonique Pilote par Jets Transversaux*
Leplat, M., Office National d'Etudes et de Recherches Aerospatiales, France; Champigny, P., Office National d'Etudes et de Recherches Aerospatiales, France; Girard, G., Aerospatiale Missiles, France; Hachemin, J. V., Aerospatiale Missiles, France; Delattre, N., Aerospatiale Espace and Defense, France; Nov. 1998; 10p; In French. Also announced as 19990017801; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This paper presents experimental and numerical work undertaken by AEROSPATIALE and ONERA on a schematic interceptor configuration in the presence of a transversal central jet. Tests were performed in the ONERA S3MA wind tunnel which consist: plotting the skin pressure over the entire body, weighing the loads and moments caused by the jet's presence, along with visualizations using Schlieren photography. The effects of variations in the jet conditions, condition of the boundary layer and the incidence of the missile were studied for supersonic airflows upto M(n) = 5.5. Additionally, Navier-Stokes calculation were carried out by the two partners using the FLU3M code for laminar and turbulent airflows. Comparison of the numerical results with the experiment shows a good reproduction of the transversal jet interaction phenomena with external airflow, in particular, a good account of the major viscous effects for this type of configuration.
Author
Missiles; Missile Configurations; Missile Design; Computational Fluid Dynamics; Wind Tunnel Tests; Viscous Flow; Navier-Stokes Equation; Hypersonics; Missile Control; Jet Flow

19990017817 Daimler-Benz Aerospace A.G., Munich, Germany
Navier Stokes Simulation Around a High Velocity Missile with Cross-Flow Jet
Hitzel, S. M., Daimler-Benz Aerospace A.G., Germany; Hennig, P., Deutsche Aerospace A.G., Germany; Esch, H., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Nov. 1998; 12p; In English; Also announced as 19990017801; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The cross-flow jet technology for the control of high speed missiles was investigated by free-flight tests, Navier-Stokes simulations and experimental wind-tunnel research. While the cross-flow technology shows promising benefits for the demands of

high manoeuvrability a proper design needs detailed knowledge both of the integral effect on the missile behaviour and the corresponding details of the flow. Navier-Stokes simulations were used to support wind-tunnel work for the understanding of complex flow structures. A finite volume method was employed to simulate high velocity flow in a contour conforming block-structured mesh. The turn-around time of the mesh and the numerical solver employed was less than one week. Given latest equipment this time could have been reduced further. A qualitative comparison with wind-tunnel visualizations and pressure measurements shows good agreement. It was found necessary to develop a method by which wind tunnel results of jet interference effects can be converted to free flight conditions. DLR started a test campaign to provide experimental data as basis for a computer programs. First results include Reynolds number effects in the range 0.5 x 10(exp 6) < or = Navier stokes simulation Aroun a High Velocity Missile wit ----Doc 1 of 1 -ReiD) < or = 11 x 10(exp 6) for M = 2.8 and 0.1 x 10 (exp 6) < or = ReiD) < or = 0.8 x 10(exp 6) for M = 6.0. It is planned to investigate the influences of other parameters that cannot be simulated correctly in standard wind tunnel tests, for example non-stationary conditions, different gases, high temperatures. Currently more detailed experimental investigations are underway at the DLR, while supporting CFD calculations including high angle-of-attack settings can be executed using the very same computational mesh, funding provided. A close schedule of CFD simulation and EFD experiment provide superior turn-around and better knowledge of the flow-problems. Detailed CFD-results can provide the undisturbed flow simulation and thus the missing link in between mass-data of integral forces and moments pro- duced by the EFD wind-tunnel and the free-flight test.

Author

Missiles; Missile Configurations; Aerodynamics; Missile Design; Computational Fluid Dynamics; Missile Control; Cross Flow; Navier-Stokes Equation; Wind Tunnel Tests; Jet Control

19990017818 Office National d'Etudes et de Recherches Aerospatiales, Dept. of Basic Experimental Aerodynamics, Meudon, France

Basic Study on the Aerodynamic and Thermal Aspects of Airflows on Missile Afterbodies *Etudes Fondamentales sur les Aspects Aerodynamiques et Thermiques des Ecoulements a l'Arriere-Corps des Missiles*

Servel, P., Office National d'Etudes et de Recherches Aerospatiales, France; Reijasse, P., Office National d'Etudes et de Recherches Aerospatiales, France; Benay, R., Office National d'Etudes et de Recherches Aerospatiales, France; Corbel, B., Office National d'Etudes et de Recherches Aerospatiales, France; Nov. 1998; 16p; In French; Also announced as 19988017801; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Airflows on the afterbodies of devices such as missiles exert a crucial influence on their "base" drag and therefore on their thrust balance. Moreover, th y have a clear influence on the aerothermic loads exerted upon this rear section, which is subjected to high temperatures from the propulsion jet coming out of the nozzle, which is composed of hot gases leaving the combustion chamber. The demand for increasingly high-level performances by new missiles has created the need for fine-tuned forecasting methods for airflows, and for a better understanding of the physical phenomena they produce. Towards this end, basic research on airflows from Propelled afterbodies was conducted at ONERA, both in the numerical field, where a Navier-Stokes code (the NASCA code) was specially developed for this purpose, and in the experimental area, where carefully designed experiments were carried out in order to obtain a highly detailed description of these airflows and to constitute well-documented data bases for validating the numerical codes. This article describes five axisymmetric base-type airflow configurations, and presents experimental measurements and calculation results for different afterbody geometries and various types of propulsion jets (cold air, hot air, and hot gases resulting from combustion of a propellant).

Author

Missiles; Aerothermodynamics; Missile Design; Air Flow; Navier-Stokes Equation; Afterbodies; Flow Characteristics; Missile Configurations

19990017819 Office National d'Etudes et de Recherches Aerospatiales, Dept. of Applied Aerodynamics, Paris, France

Boundary Layer in Supersonic Airflow Around a Missile Fuselage in Incidence: Experimental Study and Navier-Stokes Calculations *Couche Limite Autour d'un Fuselage de Missile en Incidence en Ecoulement Supersonique: Etude Experimentale et Calculs Navier-Stokes*

d'Espiney, P., Office National d'Etudes et de Recherches Aerospatiales, France; Champigny, P., Office National d'Etudes et de Recherches Aerospatiales, France; Baudin, D., Office National d'Etudes et de Recherches Aerospatiales, France; Pilon, J. A., Office National d'Etudes et de Recherches Aerospatiales, France; Nov.

; , 1998; 14p; In French; Also announced as 19988017801; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Detailed aerodynamic measurements (value and angle of skin friction, boundary layer Profiles ...) were recently conducted in the S2MA and S3MA ONERA wind tunnels on a warhead cylinder fuselage at Mach 2 at 0 deg. and 10 deg. of incidence. The airflow setting is turbulent (the transition of the boundary layer is released new the fuselage nose cone) and the Reynolds number

is 1.2 x 10(exp 6). Navier-Stokes calculations in turbulent airflow were performed with the FLU3M code developed by ONERA, using Baldwin-Lomax turbulence models and k-epsilon (Jones- Launder's low Reynolds formulation). Calculation-experiment comparisons are generally in agreement, although deviations exist which are primarily due to an overly high viscosity within the vortices. This leads, in particular, to late formation of secondary vortices.
Author
Missiles; Missile Configurations; Aerodynamics; Missile Design; Turbulence Models; Warheads; Air Flow; Fuselages; Boundary Layers; Supersonic Speed; Applications Programs (Computers)

19990017820 Cranfield Univ., Coll. of Aeronautics, Bedford, UK
Algebraic Turbulence Modelling for Vortical Flows Around Slender Bodies
Qin, N., Cranfield Univ., UK; Jayatunga, C., Cranfield Univ., UK; Missile Aerodynamics; Nov. 1998; 17p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

In this paper, we present a study of algebraic turbulence modelling for vortical flows based on the Baldwin-Lomax two-layer formulation. Firstly, a recent modification of the wake function in the algebraic model by Panaras for swept shock boundary layer interaction problems has bee extended for slender body vortical flows. Secondly, the reason for the failure of the Degani-Schiff model for some vortical flow problems has been analysed. Consequently, a new criterion for the determination of the modelling length scale, which is found crucial for a proper algebraic modelling for vortical flows, is proposed based on the curvature of the profile of the damped moment of vorticity. It has been demonstrated that, as compared with the popular Degani-Schiff model, both of the new algebraic models can produce much better results regarding the leeward side vortical structure for a complicated vortical flow problem around a slender body.
Author
Missiles; Missile Configurations; Aerodynamics; Missile Design; Computational Fluid Dynamics; Baldwin-Lomax Turbulence Model; Slender Bodies; Mathematical Models; Turbulent Flow

19990017821 Italian Aerospace Research Center, Capua, Italy
Filtering Algebraic Turbulence Models for Supersonic High-Incidence Missile Flows
Amato, M., Italian Aerospace Research Center, Italy; Iaccarino, G., Italian Aerospace Research Center, Italy; Nov. 1998; 12p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The application of algebraic turbulence models to the prediction of the vortical flows over missile configurations is presented in this paper. A review of available modifications of the Baldwin-Lomax model is presented; three new formulations are also discussed and tested. Two are based on a different link between the mean velocity gradients and the eddy viscosity, the third one uses some topological characteristics of the flow field to detect vortex tubes and to filter the eddy viscosity. The main advantage of these models with respect to other formulations presented in literature is the simplicity and the easy implementation even in industrial codes. The results obtained with the third model are in remarkable agreement with the experimental data.
Author
Missiles; Missile Configurations; Aerodynamics; Missile Design; Computational Fluid Dynamics; Mathematical Models; Baldwin-Lomax Turbulence Model; Supersonic Flow

19990017822 Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese, Belgium
Simulation of Laminar and Turbulent Flow Over an Ogive Cylinder
vanderWeide, E., Von Karman Inst. for Fluid Dynamics, Belgium; Deconinck, H., Von Karman Inst. for Fluid Dynamics, Belgium; Nov. 1998; 12p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The paper deals with the simulation of laminar and turbulent flow over an ogive cylinder, using an unstructured grid solver based on multidimensional upwind residual distribution schemes. For the turbulent computation use has been made of the two equation SST model of Menter, and implementation details are discussed. The solver uses a parallel implicit time integration on partioned subdomains, were message passing and parallel linear systems solvers are based on the AZTEC library of Sandia laboratories. The first computation is laminar and turns out to be the result of unsteadyness, suggesting that the test conditions are transitional in reality. The second turbulent computation is steady and results for the pressure distribution compare well with the experimental data obtained at ONERA. Significant differences between the laminar and turbulent computation are found in the vortex pattern developing on the leaside.
Author
Missiles; Aerodynamics; Computerized Simulation; Ogives; Turbulent Flow; Laminar Flow; Unstructured Grids (Mathematics); Upwind Schemes (Mathematics); Cylindrical Bodies

19990017823 Centre d'Etudes et de Recherches, Toulouse, France

Turbulence Modelling for Supersonic Missile Aerodynamics: From Mixing-Length to Reynolds-Stress Models

Thivet, Frederic, Centre d'Etudes et de Recherches, France; Deniau, Hugues, Ecole Nationale Superieure de Mecanique et d'Aerotechnique, France; Moschetta, Jean-Marc, SUPAERO, France; Hachemin, Jean-Victor, Aerospatiale Missiles, France; Nov. 1998; 12p; In English; Also announced as 19990017801; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Turbulence modelling is a key-point for the prediction of missile aerodynamics. On the basis of Parabolized Navier-Stokes computations, a variety of two-equation and Reynolds-Stress-Equation models have been analysed to assess their ability to predict relevant aerodynamical parameters for the design of missile shapes. Practical details, which are essential to implement the models in a robust and reliable way, are also given. Six test-cases, featuring flows around missile bodies at various angles of attack and including a finned configuration, are examined. Practical tools are given for missile designers to select the appropriate turbulence model, depending on the desired properties, such as accuracy, reliability... Algebraic models are shown to be dramatically impractical to predict developed vortical flows. The different levels of improvements achieved by the use of two-equation models, compressibility corrections and then Reynolds-Stress-Equation models are clearly demonstrated.

Author

Missile Bodies; Missile Configurations; Aerodynamics; Aerodynamic Characteristics; Missile Design; Turbulence Models; Navier-Stokes Equation; Finned Bodies; Supersonics

19990017824 Von Karman Inst. for Fluid Dynamics, Aeronautics/Aerospace Dept., Rhode-Saint-Genese, Belgium

Simulation of Viscous and High Temperature Gas Effects on Standard Shapes in Hypersonic Flow

Charbonnier, J.-M., Von Karman Inst. for Fluid Dynamics, Belgium; Dieudonne, W., Von Karman Inst. for Fluid Dynamics, Belgium; Paris, S., Von Karman Inst. for Fluid Dynamics, Belgium; Muylaert, J., European Space Agency. European Space Research and Technology Center, ESTEC, Netherlands; Walpot, L., European Space Agency. European Space Research and Technology Center, ESTEC, Netherlands; Nov. 1998; 10p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

In the design process of a hypersonic vehicles, the ground testing facilities are not able to provide a full simulation of the actual flight conditions. Therefore the validation of the design tools used can only be supported by partial simulations, and extrapolation to flight conditions can only be validated by flight experiments. In the frame of the European Space Agency program entitled "Hypersonic Ground Testing Comprehension and Use for Design and Computational Fluid Dynamics Support", the von Karman Institute has extended the operating envelope of the Longshot free piston hypersonic wind tunnel to the use of CO2 as test gas in addition to N2. The analysis of the influence of the specific heat ratio and viscous interaction parameter on the flow over the ELECTRE and the Hyperboloid-Flare is presented both on the experimental and numerical stand points. Finally, high temperature gas effects on these geometries are also discussed based on measurements carried out in the ONERA-F4 and DLR-HEG high enthalpy facilities to support the interest in simulating these effects using classical "cold" facilities with various test gas.

Author

Hypersonic Vehicles; High Temperature Gases; Temperature Effects; Ground Tests; Hypersonics; Flight Conditions; Viscous Flow; Wind Tunnel Tests

19990017825 Naval Surface Weapons Center, Weapons Systems Dept., Dahlgren, VA USA

A Review of Some Recent New and Improved Semi-Empirical Aeroprediction Methods

Moore, F. G., Naval Surface Weapons Center, USA; McInville, R. M., Naval Surface Weapons Center, USA; Hymer, T. C., Naval Surface Weapons Center, USA; Nov. 1998; 12p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper reviews some new and improved semiempirical aeroprediction methods developed during the last five years. Some of these methods have been incorporated into the latest version of the aeroprediction code available to the public (AP95), and all methods will be a part of the next version of the code to be released later this year (AP98). The new and improved methods include: (a) methods to compute nonlinear aerodynamics (normal force, axial force, and center of pressure) to high angle-of-attack (AOA); (b) an approach to distribute these nonlinear loads on the body and lifting surfaces; and (c) an improved method to compute aerodynamics of noncircular cross section configurations. Results of the new methods are compared to experimental data and in general, quite good agreement is obtained for a semiempirical prediction tool.

Author

Aerodynamics; Computer Programs; Aerodynamic Characteristics

19990017826 Office National d'Etudes et de Recherches Aerospatiales, Paris, France
ONERA's Aerodynamic Forecasting Code: "MISSILE" *Le Code de Prevision Aerodynamique de l'ONERA: MISSILE*
Denis, P., Office National d'Etudes et de Recherches Aerospatiales, France; Nov. 1998; 10p; In French; Also announced as 19990017801; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The MISSILE code was developed for rapid assessment of the aerodynamic characteristics of missiles from Mach 0 to Mach 10, for incidences reaching 40 deg, for steering angles of control surfaces of +/- 30, and for neutral roll angles. The methodology used in this code is based on the concept of equivalent incidence with integration of vortex effects, and combines semi-empirical and theoretical methods, along with data base correlations. Each modeling featured in this program comes from trial results or is validated latter. The potential uses of this code are presented and numerous comparisons are performed, thereby demonstrating the precision and usefulness of such a tool for geometric definition of devices in the preliminary design phase.
Author
Missiles; Aerodynamic Characteristics; Applications Programs (Computers); Missile Configurations

19990017827 Roketsan A.S. Ankara, Turkey
3D Euler and Thin Layer Navier-Stokes Solutions for Missiles at Supersonic Speeds and High Angles of Attack
Oktay, E., Roketsan A.S. Ankara, Turkey; Alemdaroglu, N., Roketsan A.S. Ankara, Turkey; Tarhan, E., Roketsan A.S. Ankara, Turkey; Champigny, P., Office National d'Etudes et de Recherches Aerospatiales, France; dEspiney, P., Office National d'Etudes et de Recherches Aerospatiales, France; Missile Aerodynamics; Nov. 1998; 12p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The purpose of this paper is to validate a 3D unstructured Euler flow solver, USER3D and a structured thin layer Navier-Stokes flow solver, TLNS, against the experimental data and to compare with the Euler and the Navier-Stokes solver, (FLU3M), of ONERA for two different missile geometries at a Mach number of M = 2 and at various angles of attack, alpha, (0 < alpha < 20 deg). The first one is a conventional missile geometry with an ogive nose, a cylindrical body and four straight tail fins. The second one is an unconventional missile geometry with a lenticular body and no tail fins. The present results are found to be in good agreement with the available results and the differences observed between them are explained in detail. The unstructured Euler code, USER3D, proved to be accurate, fast and reliable for determining the overall aerodynamic characteristics of the missiles whereas the thin layer Navier-Stokes (TLNS) solutions are found to be effective in predicting the detailed viscous behaviour of the flow field over the conventional and unconventional missile geometries studied.
Author
Missile Bodies; Missile Configurations; Aerodynamic Characteristics; Missile Design; Computational Fluid Dynamics; Euler Equations of Motion; Supersonic Speed; Viscous Flow; Applications Programs (Computers); Navier-Stokes Equation

19990017828 Middle East Technical Univ., Ankara, Turkey
Computational Investigations of Subsonic High Angle of Attack Missile Flows
Tuncer, Ismail H., Middle East Technical Univ., Turkey; Platzer, Max F., Naval Postgraduate School, USA; VanDyken, Robert D., Naval Air Warfare Center, USA; Nov. 1998; 10p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

In this paper recent computations of subsonic flow over a complete missile configuration and an ogive-cylinder using the Navier-Stokes solver OVERFLOW and the panel code PMARC are reviewed. Navier-Stokes solutions for the complete missile are presented for angles of attack up to sixty degrees. The agreement with available force and moment data is quite good up to thirty degrees, but starts to deviate for the higher incidences. It is also shown that the panel code solutions over the missile forebody provides an efficient solution and good agreement with the Navier-Stokes calculations for incidence angles up to ten degrees. Flow over an ogive-cylinder computations shows that this agreement can be extended to approximately twenty degrees if vortex wakes shed from the cylindrical body are incorporated into the panel code. The paper concludes with suggestions for future work.
Author
Missiles; Missile Configurations; Missile Design; Computational Fluid Dynamics; Cylindrical Bodies; Navier-Stokes Equation; Ogives; Panel Method (Fluid Dynamics); Subsonic Flow; Wakes; Forebodies; Applications Programs (Computers)

19990017830 Army Research Lab., Aberdeen Proving Ground, MD USA
Computational Fluid Dynamics Modeling of Multibody Missile Aerodynamic Interference
Sahu, Jubaraj, Army Research Lab., USA; Edge, Harris L., Army Research Lab., USA; Heavey, Karen R., Army Research Lab., USA; Ferry, Earl N., Army Research Lab., USA; Nov. 1998; 12p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Computational fluid dynamics (CFD) calculations have been performed for a multibody system consisting of a main missile and a number of submunitions. Numerical flow field computations have been made for various orientations and locations of submunitions using an unsteady, zonal Navier-Stokes code and the Chimera composite grid discretization technique at transonic speeds and zero degree angle of attack. Both steady-state and unsteady numerical results have been obtained and compared for a two-submunitions and missile system. Computed results show the details of the expected flow field features including the shock interactions. Computed results are compared with limited experimental data obtained for the same configuration and conditions and are generally found to be in good agreement with the data. Comparison of the unsteady and steady-state results do show an appreciable change in the aerodynamic forces and moments.

Author

Missile Bodies; Missile Configurations; Computational Fluid Dynamics; Navier-Stokes Equation; Mathematical Models; Computational Grids; Zero Angle of Attack; Transonic Speed; Aerodynamic Interference; Grid Generation (Mathematics); Missile Systems

19990017833 Raytheon Systems Co., Systems Design Lab., Tewksbury, MA USA

Role of CFD in Missile Aerodynamic Design: A Review of Recent Efforts at Raytheon

Srivastava, B., Raytheon Systems Co., USA; Furtek, J., Raytheon Systems Co., USA; Shelton, A., Raytheon Systems Co., USA; Paduano, R., Raytheon Systems Co., USA; Nov. 1998; 20p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Computational Fluid Dynamics (CFD) predictions for several supersonic missile models with wings, tails, divert jets, wire covers and strakes at several angles-of-attack and tail fin deflections of 10 and 20 deg are compared with the model wind tunnel tests. The results show excellent comparisons of all forces and moments with the measured data. Additional several example studies are discussed to show that these predictive capabilities provide a powerful design and analysis tool that can be judiciously combined with the wind tunnel tests to reduce the overall system development cost and to enhance the system reliability for the current and future generation missiles.

Author

Missiles; Missile Configurations; Aerodynamics; Missile Design; Computational Fluid Dynamics; Design Analysis; Missile Bodies; Supersonic Speed

19990017834 Sverdrup Technology, Inc., Arnold Engineering Development Center Group, Arnold AFS, TN USA

Missile Aerodynamic Testing at the Arnold Engineering Development Center (AEDC)

Marquart, Edward J., Sverdrup Technology, Inc., USA; Lawrence, William R., Sverdrup Technology, Inc., USA; Lawrence, F. Clark, Sverdrup Technology, Inc., USA; Nov. 1998; 10p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

With the need for missiles to become more maneuverable and at the same time cost less to develop, the ground testing methodology for the development of modern missiles is being redesigned at the Arnold Engineering Development Center (AEDC). The AEDC, located in middle Tennessee, USA, is one of the major ground test complexes in the world and has continuous-flow wind tunnel facilities to evaluate test articles at speeds from Mach number 0.1 to Mach number 10. Modern missiles are flying at increasingly higher angles of attack using fins and/or jets (both pulsating and continuous flow) for control and maneuverability. Dynamic and transient missile aerodynamic ground test measurements are becoming increasingly important for modern missile autopilot development. The recent advances and planned improvements at the AEDC in missile ground test measurement technology that allow the development of advanced missile autopilots and control systems at a reduced cost are discussed. Test hardware and testing methodology for missiles both with and without jet control that acquire and verify all static, dynamic, and transient aerodynamic information for modern missile autopilot development in three separate wind tunnel tests are detailed.

Author

Missiles; Aerodynamics; Missile Design; Wind Tunnel Tests; Automatic Pilots; Ground Tests; Missile Tests; Missile Control; Continuum Flow; Static Stability

19990017836 Kongsberg Defence and Aerospace A/S, Kongsberg, Norway

Air Intake Studies: Experimental Measurements and Computational Modelling

Abrahamsen, P. E. H., Kongsberg Defence and Aerospace A/S, Norway; Reif, B. A. Pettersson, Kongsberg Defence and Aerospace A/S, Norway; Saetran, L., Norwegian Univ. of Science and Technology, Norway; Fossdal, J. B., Kongsberg Defence and Aerospace A/S, Norway; Nov. 1998; 8p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The flow in an S-shaped air intake has been studied, using experimental and computational methods. The results have been compared with available experimental data. In the computational study a non-linear eddy viscosity model has been compared with a linear counterpart. In the experimental study, measurements of an Isentropic Light Piston Tunnel has been carried out. The results of the study show that the described methodology can be used for air intake design.
Author
Missiles; Computational Fluid Dynamics; Mathematical Models; Air Intakes; Engine Design; Engine Parts

19990017838 Bodenseewerk Geraetetechnik G.m.b.H., Ueberlingen, Germany
Coupled Aerokinetic Heating of Missile Structures at High Velocities
Koerber, Stefan R., Bodenseewerk Geraetetechnik G.m.b.H., Germany; Nov. 1998; 10p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This paper presents a numerical tool to calculate the aerokinetic heating of missile structures flying at high velocities. It is intended to support wind tunnel tests and enable engineers to do design variations, in a cheaper and a more time saving manner compared to experiments. The numerical method consists of two programs, one to calculate the flow around the missile configuration via a super/hypersonic computational fluid dynamics (CFD) code (solved for the Navier-Stokes-equations) and another to simulate the temperature (and stress) evolution within the bulk material via a multi-dimensional heat transfer code. Both programs are coupled using a surface energy-balance method which accounts for the permanent physical interactions at the missile's surface. In order to save CPU-time without loosing neither accuracy nor numerical stability or constancy a so-called loose coupling of both modules is presented. This method is applied to several test cases. Since the aerokinetic heating mostly effects those components located in the vicinity of the nose region of the missile, a blunt-body nose and a flat IR-window integrated in the nose were investigated. For some test cases experimental data from either wind tunnel tests and/or free flight experiments are available and are compared to the numerical results.
Author
Missiles; Computational Fluid Dynamics; Aerothermodynamics; Aerodynamic Heating; Blunt Bodies; Missile Structures; Navier-Stokes Equation; Temperature Effects; Missile Configurations; Heat Transfer; Hypersonics

19990017840 Defence Evaluation Research Agency, High Speed and Weapon Aerodynamics, Mechanical Sciences Sector, Bedford, UK
Time-Averaged and Unsteady Loads on a Missile at Launch From an Internal Weapons Bay
Ross, J. A., Defence Evaluation Research Agency, UK; Odedra, J., Defence Evaluation Research Agency, UK; Nov. 1998; 12p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper describes an experimental programme which has investigated the component loads acting on a typical missile (AMRAAM) when located within weapons bays of different geometry. Measurements have been made of wing panel loads, fin panel loads and body pressure distributions. Both time-averaged (steady-state) and unsteady pressures have been measured. The effects of weapon bay doors on the pressures and panel loads acting on the missile have also been measured. It is shown that the measured results can be used to understand the differing total loads measured on the missile in earlier tests, and thus provide an insight into developing appropriate ways of minimising carriage and release problems identified in earlier experimental programmes.
Author
Air to Air Missiles; Aerodynamic Loads; Missile Tests; Pressure Distribution; Launching; Missile Structures; Pressure Measurement; Stability Derivatives

19990017876 Defence Science and Technology Organisation, Information Technology Div., Melbourne, Australia
Functions for Writing and Reading Time History Data
Brian, Geoff; Jun. 1998; 39p; In English
Report No.(s): AD-A355673; DSTO-GD-0183; DODA-AR-010-554; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The manipulation of time history data is one of the most common activities conducted when analyzing aircraft flight behavior and performance, and as a result there exists a multitude of data formats individualized for specific applications. Air Operations Division (AOD), of the Defense Science and Technology Organization, have chosen to support two time history data formats defined by NASA Dryden Flight Research Center for development of flight behavior and performance applications. A suite of functions for writing and reading the selected NASA time history data formats have been developed at AOD. These functions may

be incorporated into analysis applications to reduce development time for new software, and to improve the sharing of data between applications.
DTIC
Flight Characteristics; Aerodynamic Characteristics; Data Management

19990017993 DYNACS Engineering Co., Inc., Brook Park, OH USA
A Summary of Validation Results for LEWICE 2.0
Wright, William B., DYNACS Engineering Co., Inc., USA; Dec. 1998; 24p; In English; 37th; Aerospace Sciences, 11-14 Jan. 1999, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAS3-98022; RTOP 548-20-23
Report No.(s): NASA/CR-1998-208687; NAS 1.26:208687; E-11467; AIAA Paper 99-0249; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A research project is underway at NASA Lewis to produce a computer code which can accurately predict ice growth under any meteorological conditions for any aircraft surface. This report will present results from version 2.0 of this code, which is called LEWICE. This version differs from previous releases due to its robustness and its ability to reproduce results accurately for different point spacing, and time step criteria across general computing platforms. It also differs in the extensive amount of effort undertaken to compare the results in a quantifiable manner against the database of ice shapes which have been generated in the NASA Lewis Icing Research Tunnel (IRT). The complete set of data used for this comparison is available in a recent contractor report . The result of this comparison shows that the difference between the predicted ice shape from LEWICE 2.0 and the average of the experimental data is 7.2% while the variability of the experimental data is 2.5%.
Author
Ice Formation; Computer Programs; Ice; Spacing; Weather

19990018113 Department of the Navy, Washington, DC USA
Omnidirectional and Controllable Wing Using Fluid Ejection
Rogers, Ernest O., Inventor; Imber, Robin D., Inventor; Jun. 16, 1998; 6p; In English; Supersedes US-Patent-Appl-SN-734824
Patent Info.: Filed 22 Oct. 1996; US-Patent-Appl-SN-734,824; US-Patent-5,765,776
Report No.(s): AD-D019991; No Copyright; Avail: US Patent and Trademark Office, Microfiche

A vehicular lift wing having a Coanda edge perimeter, is provided with a nozzle slot formation from which fluid ejection is directed tangentially from the full Coanda edge perimeter during translation through an ambient fluid medium. Omnidirectional control means supplies pressurized fluid to the nozzle slot formation at different azimuthal locations along the Coanda edge perimeter for selectively controlled generation of dynamic forces exerted on the wing.
DTIC
Coanda Effect; Wings; Dynamic Loads; Slots; Trailing Edges

19990018234 Colorado Univ., Aerospace Engineering Sciences, Boulder, CO USA
Supersonic Aerodynamics: Lift and Drag
Seebass, Richard, Colorado Univ., USA; Woodhull, John R., Colorado Univ., USA; Nov. 1998; 6p; In English; Also announced as 19990018232; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

We briefly review here the fundamentals of generating lift, and what this costs us in inviscid drag at supersonic speeds in the context of the optimum aerodynamic design. The supersonic area rule tells us how to determine the wave drag and this leads to the minimum possible inviscid drag for a supersonic aircraft. We understand from this, then, the trade-off between induced drag and wave drag due to lift. Finally, viscous effects are considered briefly. These determine the altitude at which the aircraft will fly and this sets its Csub L) and thereby its aerodynamic performance.
Author
Supersonic Aircraft; Supersonic Transports; Aerodynamics; Supersonic Drag; Lift

19990018236 Academy of Sciences (USSR), Institute of Theoretical and Applied Mechanics, Novosibirsk, USSR
Complex Experimental Studies of SST. Pt. 1: Aerodynamics of Individual Elements
Kharitonov, A. M., Academy of Sciences (USSR), USSR; Nov. 1998; 26p; In English; Also announced as 19990018232; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The achievement of aerodynamic perfection of supersonic flying vehicles is determined to a large extent by the depth of understanding of aerodynamics of the main aircraft elements and the optimum use of aerodynamic interference of individual elements: wing, fuselage (airframe), engine nacelle, and other superstructures. A successful solution of these problems requires the

study of regularities of three-dimensional flow around the developed geometric configurations, which is characterized at supersonic speeds by the presence of shock waves and expansion fans, and by their interaction with each other and with boundary layers. In most cases, these interactions involve multiple separations and reattachments of boundary layers, the size and position of separation regions are determined by the body geometries, flight conditions, and/or relative positions of the bodies in space. These problems form one of the basic experimental research directions of the Aerodynamics Laboratory of the Institute of Theoretical and Applied Mechanics SB RAS. Vast experimental information has been accumulated on the flow around both schematic configurations of promising flying vehicles and models of specific aircraft under development. All experiments were conducted in the supersonic wind tunnel T-313 of ITAM SB RAS equipped with specially developed devices, methodology, and software for the study of interference of various aircraft elements. The wind tunnel T-313 of our Institute is a blowdown tunnel with square test section (size 0.6 x 0.6 m) and Mach number range from 2 to 6. A multiple statistical analysis for various Mach numbers allows one to characterize the nonuniformity of the field of velocities in the zone of model location for the last twenty-five years of the wind tunnel performance. The nonuniformity degree of the field of velocities in the test section is maintained at a level not exceeding 0.5%. Multiple measurements of accuracy reference models as against the similar data obtained in various wind tunnels. The present lecture is devoted to various aspects of HSCT aerodynamics which yield a notion of versatility and complexity of experiments and obtained results. Apart from their own significance, these results are of interest for verification of the computational fluid dynamics (CFD) models and methods. All experimental investigations obtained in the Aerodynamics Laboratory of Institute of Theoretical and Applied Mechanics (ITAM) SB RAS were initiated and supported by the Aerodynamics Department of the Tupolev Aviation Company.

Author

Supersonic Transports; Aerodynamic Characteristics; Aerodynamic Interference; Aircraft Design; Aerodynamics; Wind Tunnel Tests; Aircraft Parts; Aircraft Structures

19990018239 Academy of Sciences (USSR), Inst. of Theoretical and Applied Mechanics, Novosibirsk, USSR

Complex Experimental Studies of SST, Pt. 2, Aerodynamic Interference of Various Elements

Kharitonov, A. M., Academy of Sciences (USSR), USSR, Nov. 1998, 14p. In English. Also announced as 19990018232. Copyright Waived. Avail: CASI; A03, Hardcopy; A03, Microfiche

The results of complex experimental studies of aerodynamic interference of various elements of supersonic transport aircraft are presented. The objective was a detailed study of local SST aerodynamics, which was aimed at seeking the methods of increasing the aerodynamic perfectness of these vehicles. The results presented include the study of interference of a schematized wing with the body, wing with engine nacelles, wing with various superstructures, and wing with engine jets. A supersonic flow around all these configurations is accompanied by complex three-dimensional flows with shock wave/boundary layer interactions, boundary layers on the regions of surface junctions, diffraction flows, etc. Capabilities of the developed measurement techniques of the own aerodynamic characteristics of various elements and the contribution of the wing, the body, and the superstructures, as well as their mutual positions, to the characteristics of their combinations. The methods of increasing the lift-to-drag ratio of SST models are shown in a number of cases. At the same time, the results presented can be used as test cases for Computational Fluid Dynamics (CFD) validation.

Author

Aerodynamic Interference; Aerodynamic Characteristics; Aerodynamics; Transport Aircraft; Supersonic Transports; Aircraft Parts; Aircraft Structures

19990018242 NASA Langley Research Center, Hampton, VA USA

Status of NASA High-Speed Research Program

Whitehead, Allen H., Jr., NASA Langley Research Center, USA, Nov. 1998, 20p. In English. Also announced as 19990018232. Copyright Waived. Avail: CASI; A03, Hardcopy; A03, Microfiche

This paper provides an overview of the NASA High-Speed Research (HSR) Program dedicated to establishing the technology foundation to support the US transport industry's decision for an environmentally acceptable, economically viable 300 passenger, 5000 n.mi., Mach 2.4 aircraft. The HSR program, begun in 1990, is supported by a team of US aerospace companies. The international economic stakes are high. The projected market for more than 500 High-Speed Civil Transport (HSCT) airplanes introduced between the years 2000 and 2015 translates to more than $200 billion in aircraft sales, and the potential of 140,000 new jobs. The paper addresses the history of supersonic commercial air transportation beginning with the Concorde and TU-144 developments in the early 1960 time period. The technology goals for the HSR program are derived from market study results, projections on environmental requirements, and technical goals for each discipline area referenced to the design and operational features of the Concorde. Progress since the inception of the program is reviewed and a summary of some of the lessons learned will be highlighted. An outline is presented of the remaining technological challenges. Emphasis in this paper will be on the traditional aero-

nautical technologies that lead to higher performance to ensure economic viability. Specific discussion will center around aerodynamic performance, flight deck research, materials and structures development and propulsion systems. The environmental barriers to the HSCT and that part of the HSR program that addresses those technologies are reviewed and assessed in a companion paper.
Author
Supersonic Transports; Transport Aircraft; Air Transportation; Aeronautical Engineering; High Speed; Commercial Aircraft

19990018243 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen, Germany
Geometry Tools for Multidisciplinary Optimization
Sobieczky, Helmut, Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Germany; Nov. 1998; 8p; In English; Also announced as 19990018232; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Design tools for high speed design aerodynamics are developed using sets of mathematical functions to create curves and surfaces in 3D space, steady or moving for unsteady phenomena, adaptation and optimization. Coupled with fast grid generation, input CFD verification of preliminary design variations may be created. Aerodynamic applications for conventional (HSCT) and novel (OFW) supersonic transport aircraft are illustrated, with future prospects to use geometry generation of internal structures, control surfaces and engines for multidisciplinary optimization. The geometry generator is a preprocessor to provide knowledge-based input for Computer Aided Design (CAD) and CFD methods.
Author
Multidisciplinary Design Optimization; Computer Aided Design; Supersonic Transports; Transport Aircraft; Aerodynamics; Computational Fluid Dynamics; Computational Geometry; High Speed

19990018249 National Aeronautical Lab., Advanced Technology Aircraft Project Center, Tokyo, Japan
Aerodynamic Research for a Second Generation SST in Japan Including Laminar Flow Control and Low Sonic Boom Design
Yoshida, Kenji, National Aeronautical Lab., Japan; Nov. 1998; 24p; In English; Also announced as 19990018232; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The outline of aerodynamic researches on a second generation SST in Japan and results of the individual research on the supersonic laminar flow control (LFC) and the low sonic boom design are described. LFC effect was examined by the wind tunnel tests of the warped delta wing model with a LFC device, and by the numerical analysis with originally developed e(exp N) method together with a new assumption. As for the low boom technology, Darden's theory was applied for designing the aerodynamic configuration and its characteristics was investigated numerically in order to clarify the effects of nose shape and Mach number. Wind tunnel tests and Euler CFD analysis were performed for the evaluation. Further trial for improvements of lift-to-drag ratio and trim constraint is proposed with regard to real airplane design.
Author
Sonic Booms; Aerodynamic Configurations; Aircraft Design; Supersonic Transports; Wind Tunnel Tests; Computational Fluid Dynamics; Aerodynamics; Laminar Boundary Layer; Computer Aided Design

19990018250 Office National d'Etudes et de Recherches Aerospatiales, Paris, France
The Aerodynamics of the Future Supersonic Transport Aircraft: Research Activities at ONERA
Thibert, J. J., Office National d'Etudes et de Recherches Aerospatiales, France; Nov. 1998; 26p; In English; Also announced as 19990018232; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The paper gives an overview of the Office National d'Etudes et de Recherches Aerospatiales (ONERA) activities concerning the aerodynamics of the future supersonic transport aircraft. In a first part detailed comparisons between CFD and wind tunnel data are presented and discussed. The second part addresses the problem of the drag prediction in cruise flight conditions from wind tunnel data. Skin friction coefficients values measured in flight are compared to the results of boundary layer computations. The third part is devoted to wing designs with numerical optimisation techniques. Several examples are presented and discussed. Results concerning riblets and laminar flow control are given in a fourth part which also presents experiments carried out for attachment line contamination investigation. A quiet supersonic tunnel for basic research on supersonic laminar flows is also presented. The last part of the paper deals with activities on air intakes aerodynamics. After a brief recall of supersonic air intakes operational modes and a description of the Concorde air intake, comparisons between CFD and wind tunnel data on a generic 2D intake are presented. Basic experiments on intake internal flow are described and the problem of the internal shock control is addressed. Examples of the use of CFD for auxiliary air intakes design are given.
Author
Aerodynamics; Supersonic Transports; Wind Tunnel Tests; Computational Fluid Dynamics; Transport Aircraft

19990018277 Naval Postgraduate School, Monterey, CA USA
Development and Verification of an Aerodynamic Model for the NPS Frog UAV Using the CMARC Panel Code Software Suite
Pollard, Stephen J.; Sep. 1998; 195p; In English
Report No.(s): AD-A354951; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

The CMARC panel-code is evaluated for the development of an aerodynamic model of the Naval Postgraduate School FROG Unmanned Air Vehicle (UAV). CMARC is a personal computer hosted panel-code software suite for solving inviscid, incompressible flow over complex three-dimensional bodies. A panel model of the NPS FROG UAV is developed to obtain stability derivative data at the cruise flight condition. Emphasis is placed on comparing the CMARC data to aerodynamic models obtained from classical design techniques and parameter estimation. Linearized longitudinal and lateral-directional state-equation models are used to compare the dynamic response of each data set. In addition, CMARC is used to generate static-source and angle-of-attack sensor position corrections. Position corrections are provided in look-up table and curve-fit formats. The aerodynamic model obtained with CMARC demonstrated higher fidelity dynamic longitudinal response than the classical design model. Dynamic lateral-directional response is similar to that obtained from classical design techniques. Adjustment through comparison with flight-test data is still required to optimize the CMARC model. Future studies should concentrate on improving CMARC modeling of fuselage side force through the addition of wake separation lines. Additionally, the propeller disk should be modeled in an attempt to capture the effects of increased dynamic pressure over the horizontal and vertical tail surfaces.
DTIC
Computer Programs; Panel Method (Fluid Dynamics); Incompressible Flow; Inviscid Flow; Mathematical Models; Equations of State; Three Dimensional Bodies; Aerodynamic Characteristics

19990018835 NASA Lewis Research Center, Cleveland OH USA
A Review of NASA Lewis' Development Plans for Computational Simulation of Aircraft Icing
Potapczuk, Mark G., NASA Lewis Research Center, USA; Jan. 1999; 20p; In English; 37th; Aerospace Sciences, 11-14 Jan. 1999, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 548-21-23
Report No.(s): NASA/TM-1999-208804; E-11517; NAS 1.15:208804; AIAA Paper 99-0243; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The use of computational methods in the simulation of flight in icing conditions is an ongoing research effort by the Icing Branch at the NASA Lewis Research Center. The development of accurate, robust, well-documented, well-maintained computational tools is a major function of the research activities of the Icing Branch, in collaboration with its grantees and contractors. The goal of the Icing Branch's efforts is to provide simulation methods that can be used to aid in design, testing, certification, and qualification efforts related to flight in icing conditions. This paper will detail the current research and plans for future efforts in the development of computational tools for simulation of ice accretion, ice protection systems, the effects of ice on aircraft performance characteristics, and the behavior of aircraft systems subjected to icing conditions.
Author
Aircraft Icing; Software Development Tools; Flight Simulation; Mathematical Models; Ice Formation; Ice Prevention

03
AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations, and aircraft accidents.

19990018030 Federal Aviation Administration, Washington, DC USA
Notices to Airmen: Domestic/International
Oct. 08, 1998; 222p; In English
Report No.(s): PB99-109035; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

The main references for changes to the National Airspace System (NAS) are the Aeronautical Charts and the Airport/Facility Directories. Most changes to the NAS meeting NOTAM criteria are known sufficiently in advance to be carried in these publications. When this cannot be done, changes are carried in the Notices to Airmen publication and/or the Service. A telecommunications system as a NOTAM D item. FDC NOTAMs reflect changes to Standard Instrument Approach Procedures (SIAPs), flight restrictions, and aeronautical chart revisions.
NTIS
Instrument Approach; Flight Conditions; Air Traffic

19990018135 Naval Postgraduate School, Monterey, CA USA
A Human Error Analysis and Model of Naval Aviation Maintenance Related Mishaps
Schmorrow, Dylan D., Sep. 1998; 147p; In English
Report No.(s): AD-A355995; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Naval Aviation is in the midst of a major transformation as it attempts to come to terms with the demands of maintaining operational readiness in the face of diminishing budgets and reduced manning. Diminishing operating and procurement budgets mean that Naval Aviation is for the most part "making do" with existing aircraft. Over the past decade, one in four Naval Aviation mishaps were partially attributable to maintenance error. The present operating environment underscores the need to address maintenance error and its causes. The current study accomplishes three things. First, it evaluates 470 Naval Aviation mishaps with distinct maintenance error correlates. Second, it categorizes those errors using a taxonomy based upon current organizational and psychological theories of human error. Third, it mathematically models the consequences of these errors and uses the models to (a) predict the frequency with which maintenance-based mishaps will occur in the future and (b) approximate the potential cost savings from the reduction of each error type.
DTIC
Aircraft Accidents; Aircraft Maintenance; Error Analysis; Human Factors Engineering; Human Performance

19990018233 Colorado Univ., Aerospace Engineering Sciences, Boulder, CO USA
History and Economics of, and Prospects for, Commercial Supersonic Transport
Seebass, Richard, Colorado Univ., USA; Woodhull, John R., Colorado Univ., USA; Nov. 1998; 6p; In English; Also announced as 19990018232; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Commercial transport at supersonic speeds has been a reality since 1976. Indeed, it has been a great technical success. The Concorde fleet has flown approximately 350,000 hours, most of them at supersonic speeds, and it has done so with high reliability. The twelve Concordes operating today have accumulated more supersonic flight hours than all of the world's military aircraft. These Concordes will be in service for many years to come. Scheduled Concorde flights are principally London - New York, Paris - New York. Reports on the Concorde indicate that the dozen now in service are well, but not always fully, utilized. The Concorde has been a success for the two airlines that operate this small fleet. Does a second generation SST make sense? This paper reviews the past programs and provides the author's own conclusion regarding the prospects for commercial supersonic transport.
Author
Commercial Aircraft; Airline Operations; Economics; Air Transportation; Concorde Aircraft

19990018601 NASA Lewis Research Center, Cleveland, OH USA
An Experimental and Numerical Study of Icing Effects on the Performance and Controllability of a Twin Engine Aircraft
Reehorst, A., NASA Lewis Research Center, USA; Chung, J., NASA Lewis Research Center, USA; Potapczuk, M., NASA Lewis Research Center, USA; Choo, Y., NASA Lewis Research Center, USA; Wright, W., DYNACS Engineering Co., Inc., USA; Langhals, T., DYNACS Engineering Co., Inc., USA; January 1999; 20p; In English; 37th; Aerospace Sciences, 11-14 Jan. 1999, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 548-20-23
Report No.(s): NASA/TM-1999-208896; E-11495; NAS 1.15:208896; ICOMP-99-02; AIAA Paper 99-0374; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In September 1997 the National Transportation Safety Board (NTSB) requested assistance from the NASA Lewis Research Center (LeRC) Icing Branch in the investigation of an aircraft accident that was suspected of being caused by ice contamination. In response to the request NASA agreed to perform an experimental and computational study. The main activities that NASA performed were LERC Icing Research Tunnel (IRT) testing to define ice shapes and 2-D Navier-Stokes analysis to determine the performance degradation that those ice shapes would have caused. An IRT test was conducted in January 1998. Most conditions for the test were based upon raw and derived data from the Flight Data Recorder (FDR) recovered from the accident and upon the current understanding of the Meteorological conditions near the accident. Using a two-dimensional Navier-Stokes code, the flow field and resultant lift and drag were calculated for the wing section with various ice shapes accreted in the IRT test. Before the final calculations could be performed extensive examinations of geometry smoothing and turbulence were conducted. The most significant finding of this effort is that several of the five-minute ice accretions generated in the IRT were found by the Navier-Stokes analysis to produce severe lift and drag degradation. The information generated by this study suggests a possible scenario for the kind of control upset recorded in the accident. Secondary findings were that the ice shapes accreted in the IRT were mostly

limited to the protected pneumatic boot region of the wing and that during testing, activation of the pneumatic boots cleared most of the ice.

Author

Aircraft Icing; Aircraft Control; Wind Tunnel Tests; Computational Fluid Dynamics; Navier-Stokes Equation; Aircraft Performance; Aerodynamic Characteristics

19990018645 Naval Postgraduate School, Monterey, CA USA

Climate Survey Analysis for Aviation Maintenance Safety

Baker, Robert H.; Sep. 1998; 100p; In English

Report No.(s): AD-A356610; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

Naval Aviation has been challenged to cut its 1996 human factors related Class A flight mishap rate in half by the year 2000. Investigations show that human caused flight mishaps have not declined as rapidly as mechanical ones. From fiscal year 1990 through 1997, maintenance was a caUSAl factor in 17 percent of Class A flight mishaps. Presently, there is an ongoing effort to identify factors contributing to human error in aviation maintenance. One major component is the development of an instrument to assess safety climate and posture in maintenance operations. This thesis is the climate safety assessment portion of this effort. It utilizes and adapts an existing Model of Organizational Safety Effectiveness (MOSE) to achieve an understanding of the possible influences of organizational factors on aviation maintenance. This thesis develops and administers a prototype Maintenance Climate Assessment Survey (MCAS) that provides a tool for assessing safety in maintenance operations. The study has 268 participants from three Reserve squadrons that represent the spectrum of aviation communities. The prototype MCAS is comprised of 67 questions developed from 155 candidate questions. Each question uses a Likert type rating scale, which allows participants to express opinions for each item presented. Cluster and Factor analysis is used to identify redundancies between items and how items clustered according to the MOSE components. The product of this study is a finalized MCAS with 35 questions that can be used by the Squadron command and Aviation Safety Officer to assess their unit's safety posture in conducting scheduled/unscheduled maintenance operations.

DTIC

Cluster Analysis; Human Factors Engineering; Military Aviation; Aircraft Safety

19990019842 Army Command and General Staff Coll., School of Advanced Military Studies, Fort Leavenworth, KS USA

C-17--How to Get More for Less

Oskey, Dave L.; May 21, 1998; 56p; In English

Report No.(s): AD-A357811; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

The Department of Defense has a mission to fight and win two major theaters of war in "close succession." Mobility is the critical link, providing the capability to deploy forces and meet mission requirements. One aspect of mobility critical to meeting current and future needs is airlift. The two types of airlift are inter-theater and intra-theater airlift. The 1998 Air Mobility Master Plan, identifies a shortfall in strategic airlift capability or inter-theater airlift. The C-17 Globemaster III will provide the core for military airlift as it replaces the ageing C-141 Starlifter. The C-17 has unique capabilities that complement Force XXI initiatives, and provide the Air Force with a new capability to provide decisive intra-theater airlift. The Department of Defense force structure reveals a heavy reliance on force projection operations and mobility. to increase mobility and maximize the C-17s intra-theater airlift capability, it is critical to devise a system that will relieve the C-17 of strategic inter-theater airlift missions. This system must provide a low cost capability to move outsize cargo and the civil reserve air fleet (CRAF) is the primary candidate for change. CRAF provides a large amount of air cargo transport capability and is critical to successful deployment of US Forces during times of national crisis. However, CRAF does not provide an outsize cargo airlift capability. This monograph will recommend two courses of action that will add strategic airlift capability. This additional airlift will allow the C-17 to perform intra-theater missions. As a result forces will have a rapid response and enhanced mobility capability in the area of responsibility unlike anything experienced in the past. The C-17 has the potential to become decisive on the future battlefield.

DTIC

Mission Planning; Mobility; C-17 Aircraft

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft, air navigation systems (satellite and ground based), and air traffic control.

19990018056 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. of Flight Guidance, Brunswick, Germany
Airport Traffic Management Based on Distributed Planning
Boehme, D., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Nov. 1998; 12p; In English; Also announced as 19990018045; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Against the background of permanent growth of air traffic the development of planning principles, algorithms, and systems for the Air Traffic Management (ATM) has become an important field of air traffic research. Whilst present ATM planning systems were rather "custom-built" future planning systems will have to be cooperative. This will become true especially for Airport Traffic Management (APTM), since here ground, arrival, and departure traffic flows have to be synchronized. The paper deals with methods and algorithms that where developed in order to realize a cooperation of distributed planners within the context of APTM. Although considerations are done on example of the DLR's TARMAC concept for an ASMGCS it is the intention to treat this subject on a level of abstraction that supports an application on other domains. For the same reason some classification aspects of the interdependence of planning tasks are given. Two examples of use, distributed, cooperative taxi planning and cooperative planning of runway occupancies for arrivals and departures, are explained in detail. In one example the making of cooperation is considered under the requirement of only minor modifications of an already operating arrival planning unit.
Author
Algorithms; Air Traffic; Air Traffic Control; Flight Management Systems; Airports; Management Planning

19990018168 Civil Aeromedical Inst., Oklahoma City, OK USA
Recovery of the FAA Air Traffic Control Specialist Workforce: *Final Report, 1981-1992*
Broach, Dana, Editor, Civil Aeromedical Inst., USA; Aug. 1998; 66p; In English
Contract(s)/Grant(s): FAA-AM-97-B-HRR-509
Report No.(s): DOT/FAA/AM-98/23; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The Federal Aviation Administration was confronted in 1981 with the challenge of rebuilding its core, technical, and highly-trained air traffic control specialist (ATCS) workforce following the PATCO strike. From late 1981 through mid-1992, the FAA rebuilt this critical workforce through a large-scale testing, screening and training program. by mid-1992, recovery of the controller workforce was complete, and it was no longer necessary for the FAA to conduct a large-scale hiring program. The six papers presented in this report represent the first major retrospective analysis of the complete data set describing the recovery of the FAA's en route and terminal ATCS workforce following the 1981 controller strike. The first paper describes the personnel processes, focusing on recruitment and hiring programs for the en route and terminal options. The second paper presents a detailed description of the aptitude test battery used to evaluate over 400,000 applicants between 1981 and 1992. The third paper offers a definitive statistical portrait of the FAA Academy Screening programs as predictors of field training outcomes. On-the-job training (OJT) programs in en route and terminal facilities are described in the fourth paper. These four papers, taken together, provide a definitive description of the processes used to recruit, test, screen, and train persons for the ATCS occupation between 1981 and 1992. The fifth paper draws on FAA organizational survey data to describe controller perceptions of the organizational climate in which the workforce recovery occurred. The sixth paper analyzes current controller workforce demographics and technological trends in air traffic control to identify potential areas of future research.
Author
Air Traffic Control; Air Traffic Controllers (Personnel); Terminal Facilities; Psychological Tests; Personnel Development; Education

19990018649 Army Research Lab., Sensors Directorate, Adelphi, MD USA
Fermi Coordinates of an Observer Moving in a Circle in Minkowski Space: Apparent Behavior of Clocks
Bahder, Thomas B.; Nov. 1998; 18p; In English
Report No.(s): AD-A357062; ARL-PP-98-7; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Coordinate transformations are derived from global Minkowski coordinates to the Fermi coordinates of an observer moving in a circle in Minkowski space-time. The metric for the Fermi coordinates is calculated directly from the tensor transformation rule. The behavior of ideal clocks is examined from the observer's reference frame using the Fermi coordinates. A complicated relation exists between Fermi coordinate time and proper time on stationary clocks (in the Fermi frame) and between proper time on satellite clocks that orbit the observer. An orbital Sagnac-like effect exists for portable clocks that orbit the Fermi coordinate origin. The coordinate speed of light is isotropic but varies with Fermi coordinate position and time. The magnitudes of these line-

matic effects are computed for parameters that are relevant to the Global Positioning System (GPS) and are found to be small; however, for future high-accuracy time transfer systems, these effects may be of significant magnitude.
DTIC
Global Positioning System; Coordinate Transformations; Sagnac Effect; Time Measurement

19990019029 Miami Univ., Div. of Applied Marine Physics, FL USA
Removal of GPS Errors from Currents Determined Using VHF Radar from a Moving Ship *Final Report, 7 Nov. 1996 - 6 Nov. 1997*
Skop, Richard A.; Jan. 1998; 7p; In English
Contract(s)/Grant(s): N00014-97-1-G903
Report No.(s): AD-A357755; NRL/CR/7401-98-0011; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
This document represents the Final Technical Report for NRL Contract No. N00014-97-1-G903, -- period of performance November 7, 1996 through November 6, 1997.
DTIC
Global Positioning System; Very High Frequencies

19990019063 General Accounting Office, Resources, Community and Economic Development Div., Washington, DC USA
Air Traffic Control Status of FAA's Modernization Program
Dec. 1998; 99p; In English; Report to Congressional Requesters.
Report No.(s): AD-A357511; GAO/RCED-99-25; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche
In late 1981, the Federal Aviation Administration (FAA) began a modernization program to replace and upgrade the National Airspace System's (NAS) equipment and facilities to meet the expected increase in traffic volume, enhance the margin of air safety, and increase the efficiency of the air traffic control system-the principal component of the NAS. historically, the modernization program has experienced many problems in meeting cost, schedule, and performance goals. As a result, many of the promised benefits from using new equipment have been delayed, and the aviation community's confidence in FAA'S ability to manage the modernization program has been weakened. Because of the complexity, cost, and problem-plagued past of FAA'S modernization program, we designated it a high-risk information technology initiative in 1995 and again in 1997.' In light of past problems and continuing concerns about key projects being funded under this program, you asked us to provide current information on the status of the modernization program. As agreed with your offices, this report provides information on the (1) status of the overall modernization program, including its cost; (2) status of 18 key modernization projects; and (3) challenges facing the overall modernization program. (See app. I for specific information on these 18 projects. A listing of projects completed from 1983 through August 1998 is included in app. II.)
DTIC
Cost Effectiveness; Air Traffic Control; Information Systems; Schedules; Aircraft Safety

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

19990017804 Nielsen Engineering and Research, Inc., Mountain View, CA USA
Missile Fin Planform Optimization for Improved Performance
Lesieutre, Daniel J., Nielsen Engineering and Research, Inc., USA; Dillenius, Marnix F. E., Nielsen Engineering and Research, Inc., USA; Lesieutre, Teresa O., Nielsen Engineering and Research, Inc., USA; Nov. 1998; 12p; In English; Also announced as 19990017801
Contract(s)/Grant(s): F08630-94-C-0054; N68936-97-C-0152; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche
The aim of the research described herein was to develop and verify a fast running optimization-based aerodynamic/structural design tool for missile fin and configuration shape optimization. The developed software was used to design several missile fin planforms which were tested in the wind tunnel. Specifically, this paper addresses fin planform optimization for minimizing fin hinge moments, as well as aeroelastic design (flexible fin structures) for hinge moment control. The method is also capable of shape optimization of fin-body combinations with geometric constraints. The inclusion of aerodynamic performance, geometric

constraints, and structural constraints within the optimization software facilitates multidisciplinary analysis and design. The results of design studies and wind tunnel tests are described.
Author
Missile Configurations; Aerodynamic Characteristics; Fins; Computer Programs; Computer Aided Design; Structural Design; Missile Components

19990017805 ZONA Technology, Inc., Scottsdale, AZ USA
Aeroelastic/Aeroservoelastic Tailoring for Hinge Moment Minimization of Missile Fins
Chen, P. C., ZONA Technology, Inc., USA; Sarhaddi, D., ZONA Technology, Inc., USA; Liu, D. D., ZONA Technology, Inc., USA; Ratwani, M., R-Tec, USA; Minahen, T., Raytheon Systems Co., USA; Nov. 1998; 16p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper reports our recent development of a new missile-fin design methodology. In particular, we present the results of a feasibility study on the minimization of the hinge moment of a generic tactical missile (GTM) fin by passive profile means. The final goal is aimed at achieving a significant reduction in the feasible minimum hinge moment so that a sizable payoff in cost and performance of the whole missile system can be achieved. With the selection of a generic missile fin, a global design methodology involving three design loops has been successfully developed. Aeroelastic tailoring of a composite missile fin has been thoroughly conducted by extensively applying ASTROS+ optimization in an inner design loop. ASTROS+ is an enhanced version of a MDO software ASTROS (Automated STRuctural Optimization System) with the ZAERO module, a unified unsteady/steady aerodynamic module covering subsonic to hypersonic Mach numbers. With an optimal forward shift of the hingeline, the present aeroelastic tailored design has achieved over 25% improvement in the hinge moment reduction, while satisfying all constraints imposed by the critical flight conditions. The optimized ply thickness distribution shows promising producibility for composite fin manufacturing, and an affordable manufacturing cost can be achieved.
Author
Missiles; Aerodynamic Characteristics; Missile Design; Aeroelasticity; Missile Systems; Unsteady Aerodynamics; Hypersonics; Fins; Applications Programs (Computers); Manufacturing; Computer Aided Design

19990017806 Air Force Research Lab., Munitions Directorate, Eglin AFB, FL USA
Conformal Lifting and Control Surfaces for Weapon Stowability
Simpson, L. Bruce, Air Force Research Lab., USA; Davis, Frederick A., Air Force Research Lab., USA; Kruggel, Benjamin G., Air Force Research Lab., USA; McLaughlin, Ed, Coleman Research Corp., USA; Nov. 1998; 8p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The aerodynamic characteristics of a conformal ring-wing and wrap-around fin system were studied experimentally. The ring-wing and wrap-around fins were mounted on a body of revolution consisting of a 1.66 caliber tangent ogive nose with an 8.5 caliber afterbody. The aerodynamic performance of the system was studied at Mach 0.5 and 0.9 in a trisonic blow-down wind tunnel. Angle of attack sweeps from -10 to +20 degrees were made for yaw angles of 0, +/- 5, and +/- 12 degrees. While the conformal ring-wing and wrap-around fin system has excellent performance in storage for internal bays and tube launched dispensers, the aerodynamic results show that the lifting potential of the ring-wing was not as good as initially predicted. Asymmetric aerodynamics and cross-coupling effects were larger than normal due to the tunneling effect the ring-wing had on the airflow impinging the leeward tail surfaces.
Author
Missiles; Missile Design; Fins; Missile Components; Afterbodies; Aerodynamic Characteristics; Missile Configurations

19990017835 Shorts Missile Systems Ltd., Belfast, UK
An Experimental and Numerical Study of a Supersonic Spinning Missile
McIlwain, S. T., Shorts Missile Systems Ltd., UK; Mallon, P. C. G., Shorts Missile Systems Ltd., UK; Fleming, R. J., Shorts Missile Systems Ltd., UK; McConnell, G., Shorts Missile Systems Ltd., UK; Nov. 1998; 10p; In English; Also announced as 19980017801; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

A series of Wind Tunnel tests have been performed to determine the aerodynamic characteristics of a spinning canard controlled missile. Comparisons are made between results obtained on a spinning missile wind tunnel model, a static wind tunnel model, and computational results. The test article consisted of a free rolling missile body with a decoupled nose section. The body had four equally canted fins at the rear to provide roll whilst the decoupled nose section was fitted with two differentially set canards and attached directly to the wind tunnel balance around which the rear body was allowed to free spin. Force and moment measurements were made on the model using the wind tunnel balance system which could then be compared directly to the results of the static wind tunnel test and also to the CFD results which modelled the static case. Analysis of the dynamic data and static

data averaged over the interdigitation angular range showed a close correlation with the CFD results in the major force and moment components. However, there were significant differences observed in cross plane force and moment measurements between the static and dynamic cases and also between the static experimental result and the computational result. In the latter case the correlation was improved by including a separation model in the computational model. Further, when the experimental nose rolling moment coefficient was analysed, significant differences were observed between the static, dynamic and computational results.
Author
Missiles; Missile Configurations; Aerodynamic Characteristics; Missile Design; Missile Bodies; Canard Configurations; Wind Tunnel Tests; Wind Tunnel Models; Afterbodies; Stability Derivatives

19990017837 Rutgers - The State Univ., Piscataway, NJ USA
Optimal Missile Inlet Design by Means of Automated Numerical Optimization
Blaize, Michael, Rutgers - The State Univ., USA; Knight, Doyle, Rutgers - The State Univ., USA; Rasheed, Khaled, Rutgers - The State Univ., USA; Kergaravat, Yan, Aerospatiale Missiles, France; Nov. 1998; 10p; In English; Also announced as 19990017801
Contract(s)/Grant(s): DABT63-93-C-0064; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This paper presents a numerical method developed to optimize two-dimensional supersonic ramjet missile inlets in an automated way. The objective is to maximize the propulsive performances of the inlet, not only for one flight condition, but over an entire mission. This innovative computational process has been applied to the redesign of existing inlets and to the design of new ones. It combines an optimization algorithm which generates and selects inlet geometries, with a flow solver which calculates the inlet performances, within an automated iterative loop. The design strategy yields great improvements of the baseline inlet in a very short period of time. Successful results are presented for the optimization of a generic inlet for a typical mission. The validity of the increase in total pressure recovery achieved by the automated optimization loop is verified using Navier-Stokes computations. The application and the possible benefits of such a tool for the aerospace industry are presented through the example of AEROSPATIALE-MISSILES.
Author
Ramjet Missiles; Supersonic Inlets; Computer Aided Design; Air Intakes; Propulsion; Navier-Stokes Equation; Missile Design

19990017879 Defence Science and Technology Organisation, Melbourne Australia
Analysis of Fatigue Growth from Cold-expanded/interference Fitted Stop Drilled Holes
Callinan, R. J.; Wang, C. H.; Sanderson, S.; Jul. 1998; 39p; In English
Report No.(s): AD-A355879; DSTO-TR-0704; DODA-AR-010-604; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

When fatigue cracks are found in aircraft structures the safe life of the structure is of concern. If the fatigue life can be safely extended then aircraft operating costs can be lowered. Previous work has found that plastic expansion of a hole resulting in residual compression upon elastic recovery can result in a decrease of the mean stress under cyclic loads resulting both in an increase of life and an increased critical crack length. In an experimental program recently carried out at AMRL a procedure was used to stop drill the crack, cold work the stop hole and use interference fit plugs. This resulted in an increase of stress level by a factor of 2 for fatigue life of 10,000 Falstaff blocks. Overall it has been found that the combination of interference fit plugs with cold expansion of the stop drilled holes significantly reduce the crack driving force and hence extends the fatigue life of a cracked structure. Results achieved in this report indicate that this is a promising procedure for the life extension of RAAF aircraft structures.
DTIC
Aircraft Structures; Fatigue Life; Interference Fit; Aircraft Maintenance; Cracking (Fracturing); Hole Distribution (Mechanics); Finite Element Method; Drilling

19990017914 Defence Science and Technology Organisation, Melbourne Australia
Fractographic Inspection of the Cracking FT488/2 Removed at Program 79
Barter, S. A.; Sep. 1998; 39p; In English
Report No.(s): AD-A355953; DSTO-TN-0170; DODA-AR-010-649; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

During the inspection of the FT488/2 Bare Bulkhead Fatigue Test specimen after 79 blocks of applied loading, the starboard upper wing-attachment hole aft edge, port lower wing-attachment hole aft edge and the port upper wing-attachment hole aft edge, were found to have crack indications. This cracking was confirmed by dye penetrant inspection of the regions under load. Each of the cracked holes had multiple corner cracks, with crack depths estimated to be no more than 1 mm. With the bushes removed from the holes, the cracking appeared to be confined to the aft edges of the holes, to assess the true extent of the cracking, the crack

growth rate and nature and influence of the initiating flaws, the areas containing the cracks were cut from the bulkhead. Sixteen of the cracks were broken open for analysis and several sections were cut adjacent to the cracked regions to assess the microstructure. Apart from the wing-attachment hole cracks, one of the four-inch radii (starboard forward) also had a crack indication. This area was removed. No cracking could be found although a defect in the ion vapour deposited aluminium coating in the region of the suspected crack was noted and was probably responsible for the indication.
DTIC
Aircraft Maintenance; Nondestructive Tests; Cracking (Fracturing); Fractography; Fatigue Tests; Bulkheads

19990018031 Defense Technical Information Center, Fort Belvoir, VA USA
The DTIC Review, Unmanned Aerial Vehicles, Volume 4, Number 2 *Final Report*
Cupp, Christian M.; Levine, Phyllis; Sep. 1998; 298p; In English
Report No.(s): AD-A351447; DTIC-TR-98/10; No Copyright; Avail: CASI; A13, Hardcopy; A03, Microfiche

The military already recognizes the potential value of UAVs to perform tasks previously accomplished by manned aircraft. In addition to significantly lower costs in comparison with manned alternatives, unmanned aircraft can be tasked to fly missions deemed unduly risky for humans, both in an environmental sense as well as from the combat loss standpoint. UAV development is a serious, cost effective answer to the operational needs of the US military preparing for tomorrow's battlefield. UAVs are a key element within the concept of information dominance. The objective of this issue of The DTIC Review is to review the capabilities, design and architecture of unmanned aerial vehicles common in military and commercial activities. Many challenges remain in UAV development if the USA is to continue to improve our performance of the intelligence, surveillance and reconnaissance mission and to fully exploit this technology in the 21st century.
DTIC
Pilotless Aircraft; Aerial Reconnaissance; Remotely Piloted Vehicles

19990018036 Massachusetts Inst. of Tech., Cambridge, MA USA
An Experimental Study of Surge Control in the Allied Signal LTS-101 Helicopter Turboshaft Engine
Nelson, Eric B.; Oct. 28, 1998; 230p; In English
Report No.(s): AD-A356202; AFIT-98-119; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

Surge dynamics and surge control techniques are experimentally examined on an Allied Signal LTS-101 helicopter engine. Diffuser throat injection is used for actuation. A mean level of 95 psig air injection modifies the system dynamics. Steady state injection creates a relatively large, surge-free region of near zero characteristic slope at the speedline peak, which is conducive for control. Low frequency unsteadiness is observed prior to surge for the open loop baseline case. With mean air injection, the system has a 27 Hz surge mode, and a series of higher frequency acoustic resonances, the first of which occurs at 68 Hz. These modes are one dimensional, with no rotating stall development. Surge is stabilized in the LTS-101 using active feedback control. The control strategy is to sense upstream static pressure patterns at multiple axial locations and feed back the measured signals to a high speed valve in the air injection flow path. At 95% N1 corrected, an H-infinity compensator achieves a 0.98% reduction in stalling mass flow. This equates to 10.7% increase in the overall operating range of the engine. The H-infinity compensator achieves range extension by damping the surge mode. The scheme successfully avoids excitation of the acoustic resonances. Less complex feedback schemes are unable to achieve compressor stalling mass flow reduction. This research effort incorporates a rigorous, systematic robust control redesign process. A linear, acoustic model is derived for the transfer function relation between the high speed valve command and the static pressure signal at the inlet. The model predicts a surge mode at 27 Hz and various acoustic frequencies. Based on this model, the 68 Hz mode is attributed to acoustic resonances in the system, which includes the LTS-101 and inlet ducting.
DTIC
Surges; Active Control; Control Systems Design; Dynamic Control; Feedback Control; Gas Injection; Helicopter Engines; Thrusts; Transfer Functions; Turboshafts; H-Infinity Control

19990018112 Department of the Navy, Washington, DC USA
Neural Network Based Method for Estimating Helicopter Low Airspeed
Schaefer, Carl G., Jr., Inventor; McCool, Kelly M., Inventor; Haas, David J., Inventor; May 12, 1998; 16p; In English; Supersedes US-Patent-Appl-SN-740067
Patent Info.: Filed 24 Oct. 1996; US-Patent-Appl-SN-740,067; US-Patent-5,751,649
Report No.(s): AD-D019087; No Copyright; Avail: US Patent and Trademark Office, Microfiche

The invention is directed to a method, utilizing a neural network, for estimating helicopter airspeed in the low airspeed flight range of below about 50 knots using only fixed system parameters as inputs to the neural network. The method includes the steps

of: (1) defining input parameters derivable from variable state parameters generated during flight of the helicopter and measurable in a nonrotating reference frame associated with the helicopter; (2) determining the input parameters and a corresponding helicopter airspeed at a plurality of flight conditions representing a predetermined low airspeed flight domain of the helicopter; (3) establishing a learned relationship between the determined input parameters and the corresponding helicopter airspeed wherein the relationship is represented by at least one nonlinear equation; (4) storing the at least one nonlinear equation in a memory onboard the helicopter; (5) measuring real time values of the variable state parameters during low airspeed flight of the helicopter; (6) calculating real time values of the input parameters; (7) storing the real time values of the input parameters in the memory; (8) processing the real time values of the input parameters in accordance with the at least one nonlinear equation to determine real time airspeed; and (9) displaying the real time airspeed.

DTIC

Neural Nets; Real Time Operation; Helicopters; Flight Conditions; Airspeed; Time Measurement

19990018137 Naval Postgraduate School, Monterey, CA USA

Quantitative Structural Reliability Assurance Through Finite Element Analysis

Rice, Christopher W.; Sep. 1998; 95p; In English

Contract(s)/Grant(s): N00421-98-WR-14350

Report No.(s): AD-A355906; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Risk assessment of aging aircraft components can be achieved by operational de-rating using a safety factor subjectively selected from experience and heuristics. This investigation involves synthesizing currently available, maturing computer-aided methods into a format of objective quantitative risk assessment. The methodology is applied to quantify the effect of corrosion on P-3C main landing gear lower drag struts. This kind of synthesis is appropriate wherever structural operational risk is a concern. The P-3 has undergone many modifications since the 1950s and the lower drag struts are being scrapped due to internal surface corrosion. The corrosion process is random, resulting in pits varied spatially and in severity. These corrosion attributes are merged into a one random variable probability model. The casual relation of the corrosion to structural load is analyzed by finite elements. The structural configuration model input is provided by computer-aided drafting, verified by physical measurement. The effect of corrosion on current strut population reliability, as well as the future, is computed. The conclusion is that even under severe corrosion, compressive buckling is not an issue. All the other failure modes (compressive yielding, tensile yielding, and fracture by fatigue) can be assured by one cold temperature proof test.

DTIC

Finite Element Method; Corrosion; Computer Techniques; Failure Modes; Fracturing; Aircraft Structures; Structural Reliability; Heuristic Methods; Aircraft Maintenance

19990018151 Mississippi State Univ., Dept. of Aerospace Engineering, Mississippi State, MS USA

A Framework for Preliminary Design of Aircraft Structures Based on Process Information, Part I *Final Report*

Rais-Rohani, Masoud; Mississippi State Univ., USA; Oct. 1998; 18p; In English

Contract(s)/Grant(s): NAG1-1716; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report discusses the general framework and development of a computational tool for preliminary design of aircraft structures based on process information. The described methodology is suitable for multidisciplinary design optimization (MDO) activities associated with integrated product and process development (IPPD). The framework consists of three parts: (1) product and process definitions; (2) engineering synthesis, and (3) optimization. The product and process definitions are part of input information provided by the design team. The backbone of the system is its ability to analyze a given structural design for performance as well as manufacturability and cost assessment. The system uses a database on material systems and manufacturing processes. Based on the identified set of design variables and an objective function, the system is capable of performing optimization subject to manufacturability, cost, and performance constraints. The accuracy of the manufacturability measures and cost models discussed here depend largely on the available data on specific methods of manufacture and assembly and associated labor requirements. As such, our focus in this research has been on the methodology itself and not so much on its accurate implementation in an industrial setting. A three-tier approach is presented for an IPPD-MDO based design of aircraft structures. The variable-complexity cost estimation methodology and an approach for integrating manufacturing cost assessment into design process are also discussed. This report is presented in two parts. In the first part, the design methodology is presented, and the computational design tool is described. In the second part, a prototype model of the preliminary design Tool for Aircraft Structures based on Process

Information (TASPI) is described. Part two also contains an example problem that applies the methodology described here for evaluation of six different design concepts for a wing spar.
Author
Aircraft Design; Aircraft Structures; Structural Design; Computer Aided Design; Aircraft Production Costs; Manufacturing; Aircraft Production; Multidisciplinary Design Optimization

19990018167 Santa Clara Univ., CA USA
Development of Advanced Methods of Structural and Trajectory Analysis for Transport Aircraft *Final Report, 1 Oct. 1995 - 28 Feb. 1998*
Ardema, Mark D., Santa Clara Univ., USA; Windhorst, Robert, Santa Clara Univ., USA; Phillips, James, NASA Ames Research Center, USA; 1998; 206p; In English
Contract(s)/Grant(s): NCC2-5167; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

The effort was in two areas: (1) development of advanced methods of structural weight estimation; and (2) development of advanced methods of flight path optimization. During the Spring of 1996 both graduate student research assistants working on the project, H.C. Chou and Mark Chambers, resigned to take positions in industry. This required assigning three new Santa Clara people to the project: Dr. Lee Homberger, Associate Professor of Mechanical Engineering; Robert Windhorst, graduate student research assistant; and Frank Dickerson, undergraduate student. These new people inevitably required time to learn the ACSYNT code and the nature of the ongoing research.
Author
Transport Aircraft; Structural Weight; Mechanical Engineering; Flight Paths

19990018237 Daimler-Benz Aerospace A.G., Bremen, Germany
Required Technologies for Supersonic Transport Aircraft
Mertens, Josef, Daimler-Benz Aerospace A.G., Germany; Nov. 1998; 16p; In English; Also announced as 19990018232; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

After referring to the remarkable technology level which Concorde has achieved, the most challenging new requirements for a future Supersonic Civil Transport are presented. It is proposed how to estimate influences of technology improvements on aircraft flight performance. A survey on key technologies follows with special emphasis on aerodynamic technologies.
Author
Supersonic Transports; Concorde Aircraft; Aerodynamics; Commercial Aircraft; Technologies

19990018240 Daimler-Benz Aerospace A.G., Bremen, Germany
Multi Point Design Challenges for Supersonic Transports
Mertens, Josef, Daimler-Benz Aerospace A.G., Germany; Nov. 1998; 12p; In English; Also announced as 19990018232; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

In the lecture "Required Technologies for Supersonic Transport Aircraft" one of the new challenges for a Supersonic Commercial Transport (SCT) was multi point design for the four main design points: - supersonic cruise - transonic cruise - transonic acceleration - take-off and landing. Besides engine technology, aerodynamics are most challenged by these differing requirements. But aerodynamic solutions will only become viable when contributing to an optimum of the whole aircraft; this is to be found in cooperation with all disciplines. Here, we deal with the most important aerodynamic parameters at the different design points and consequences for aerodynamic design.
Author
Aerodynamics; Transport Aircraft; Supersonic Transports; Commercial Aircraft; Aircraft Design

19990018244 NASA Langley Research Center, Hampton, VA USA
Impact of Environmental Issues on the High-Speed Civil Transport
Whitehead, Allen H., Jr., NASA Langley Research Center, USA; Nov. 1998; 26p; In English; Also announced as 19990018232; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

This paper provides an overview of the impact of environmental issues on the design and operation of the proposed High-Speed Civil Transport (HSCT). This proposal for a new generation commercial supersonic transport is being pursued by NASA and its US industry partners in the NASA High-Speed Research (HSR) Program. A second related paper describes the overall HSR Program, including a history of supersonic transport development that led to the present program, and a brief outline of the structure of the two-phase program and its management structure. The specific objectives are to address the four major barrier environmental issues and show their impact on the design of the airplane and potentially, its mode of operation. A brief historical

perspective shows how HSR Phase I addressed these environmental topics and, with the successful completion of that program, led to the successful advocacy for the Phase II effort that followed. The Phase II program elements were discussed in the earlier paper and addressed technology programs to enhance the economic viability of the HSCT. Since many of the regulations that may effect the certification and operation of the HSCT are either not in place or well documented, a brief treatise is provided to address the status of the rules and the potential impact on the viability of the HSCT.
Author
High Speed; Civil Aviation; Supersonic Transports; Transport Aircraft; Aircraft Design; Commercial Aircraft; Environments

19990018247 National Aerospace Lab., Advanced Technology Aircraft Project Center, Tokyo, Japan
Overview of NAL's Program Including the Aerodynamic Design of the Scaled Supersonic Experimental Airplane
Yoshida, Kenji, National Aerospace Lab., Japan; Nov. 1998; 16p; In English; Also announced as 19990018232; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

National Aerospace Laboratory (NAL) is promoting on un-manned scaled supersonic experimental airplane program consisting of an un-powered and a jet-powered airplanes. The main objective of the program is to establish an integrated design system with a CFD-based optimum method aiming at higher lift-to-drag ratio characteristics through flight tests of both experimental airplanes. Presently NAL has just designed an aerodynamic configuration of the first experimental airplane. This airplane plays a role of confirming supersonic drag reduction concepts incorporated in the design. Some of them are well known as an arrow planform, a warped wing and an area-ruled body, and they are used to reduce pressure drag. Furthermore as an original and challenging concept, natural laminar flow (NLF) wing design was tried to reduce friction drag. A target pressure distribution similar to a step function was derived from physical consideration with a current practical transition prediction code. The design process consisted of two stages. At the first stage, supersonic lifting surface theory and slender body theory were used. At the second stage, CFD (Navier-Stokes) code originally developed by NAL was effectively applied. Especially for the NLF wing design, a new inverse design method with CFD analysis was developed. Based on those concepts and tools, an optimum aerodynamic configuration was designed and the designed pressure distribution was validated by wind tunnel tests. Finally flight test plan for the airplane and further studies for an optimum design of jet-powered airplane are summarized.
Author
Aerodynamic Configurations; Aircraft Design; Supersonic Aircraft; Wind Tunnel Tests; Aircraft Configurations; Computational Fluid Dynamics

19990018251 British Aerospace Public Ltd. Co., Aerodynamics Dept., Lancashire, UK
Aspects of Wing Design for Transonic and Supersonic Combat Aircraft
Probert, B., British Aerospace Public Ltd. Co., UK; Nov. 1998; 22p; In English; Also announced as 19990018232; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

This paper describes some aspects of high speed design, mainly wing design, for combat aircraft. This is done by first reviewing the fundamental features and problems posed by high speed transonic and supersonic flow and the means of alleviating them. The resulting empirical / simple rules and methods allow an initial baseline configuration to be developed which is further optimized using the most appropriate design processes - involving the use of a number of CFD codes, which are described. Each process is then illustrated by briefly considering the design of four types of high speed aircraft each optimized for a different, but overlapping, flight envelope The current need for processes to treat the design of novel configurations which have low observability is mentioned and finally current ways of working are reviewed and suggestions made for future developments in the areas of design processes, aerodynamic improvements/fixes and the potential of new physical phenomena.
Author
Aircraft Design; Wings; Supersonic Aircraft; Aircraft Structures; Aircraft Parts; Computational Fluid Dynamics; Aerodynamics

19990018281 Northwestern Univ., Evanston, IL USA
Advanced Instrumentation and Measurements for Early Nondestructive Evaluation of Damage and Defects in Aerostructures and Aging Aircraft *Final Report, 1 Apr. 1993 - 30 Jun. 1998*
Achenbach, Jan; Daniel, Isaac M.; Krishnaswamy, Sridhar; Aug. 1998; 81p; In English
Contract(s)/Grant(s): F49620-93-1-0257
Report No.(s): AD-A355893; AFRL-SR-BL-TR-98-0702; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report details the KU part of an AFOSR sponsored Vanderbilt/Northwestern University Research Initiative (URI) project. The project was divided into several tasks. New laser based ultrasonic techniques were developed including a Sagnac interferometer. This interferometer is a common-path device that is robust enough to be operated in the field. An adaptive heterodyne interferometer using photorefractive recording media was also developed for detecting ultrasound on rough surfaces. In another

task, self-focusing ultrasonic arrays were devised capable of automatically focusing on surface breaking and interior flaws. Measurement models for characterizing this device were validated through direct interferometric measurements. Also, a full-field dynamic holographic interferometer was developed for disbond detection with high spatial resolution. This device allows for real-time automatic frequency scanning of an adhesively-bonded composite structure in order to make visible any underlying disbonded regions. In addition, this report describes the application and results of nondestructive evaluation (E) and other methods to the detection and characterization of the integrity of composite materials and the evaluation of the effectiveness and reliability of composite repairs for aging aircraft. Real-time NDE methods were developed and applied to composite laminates under monotonic loading to failure. Results from ultrasonic, acoustic emission (AE) and matrix cracking measurements were correlated with the macroscopic response of the material and its degradation. The effectiveness of composite patches in controlling damage propagation in a cracked aluminum substrate under fatigue conditions was also investigated by means of ultrasonic and acousto-ultrasonic methods.

DTIC

Composite Structures; Nondestructive Tests; Real Time Operation; Failure; Airframes; Damage Assessment; Laser Applications; Ultrasonics; Instruments

19990018489 Naval Air Warfare Center, Weapons Div., Point Mugu, CA USA

Distributed Simulation Testing for Weapons System Performance of the F/A-18 and AIM-120 AMRAAM

Watson, Tom; Jan. 1998; 17p; In English

Report No.(s): AD-A357045; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

The Naval Air Warfare Center Weapons Division has established a long range, real time link between the F/A-18 Weapons System Support Facility (WSSF) at China Lake, CA and the AIM-120 Hardware in the Loop (HWIL) laboratory at Point Mugu, CA. The link was established in response to a fleet demand for information on the total weapons system performance of the Hornet and AIM-120 sub-systems in an electronic jamming environment, since AIM-120 performance is very dependent on the quality of the guidance data link provided by the host aircraft. In an effort to minimize costly flight testing, the link concept was developed to obtain actual (vice simulated) aircraft radar performance and data link updates in order to more accurately assess overall performance of the aircraft/missile system.

DTIC

Weapon Systems; Real Time Operation; Data Links; Air to Air Missiles; Jet Aircraft

19990018593 Office of the Under Secretary of Defense (Acquisitions and Technology), Washington DC, Washington, DC USA

APEX: A Model for Avionics Upgrade Planning and Execution

Logan, Glen T.; Hurst, Charles R.; Jan. 1998; 15p; In English

Report No.(s): AD-A357049; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

As our weapon systems age and fewer new systems are under development, the needs of the warfighter for more capable aircraft and systems dictate that these needs be met by modifications to the legacy aircraft the services are currently flying. For aircraft avionics, the needs for technological currency are also compounded by the mandates to operate within the safety boundaries of the National Airspace requirements. The result is a full plate for many weapon system managers in establishing a rational plan to acquire and install updated systems in the aircraft they are managing. The authors have defined an approach to this avionics planning process that is described as the APEX (Avionics Planning and Execution) model. The model process shows how to incorporate avionics requirements and modification planning into an effective and integrated plan that considers technical and business case issues. Concepts such as the development of an overall avionics migration strategy, the application of open systems and the use of life cycle cost in the decision process are shown to be key elements of the APEX process. Examples of the application of this planning method to execute ongoing programs are provided.

DTIC

Aircraft Maintenance; Avionics; Airspace

19990019012 Physical Sciences, Inc., Andover, MA USA

High Velocity Interceptor Investigations. *Final Report*

Legner, Hartmut H.; Gelb, Alan H.; Rosen, David I.; Caledonia, George E.; Sep. 1998; 103p; In English

Contract(s)/Grant(s): DAAH04-95-C-0056

Report No.(s): AD-A357979; PSI-1239/TR-1573; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

High velocity interceptors operating at low altitudes in the range from 20 to 30 km will experience a stressing aerothermal environment which can impact performance of the infrared sensor/designator system. This report addresses primarily two aspects of high velocity interceptors: a novel passively cooled window concept and the control of boundary layer transition to turbulence.

A totally new concept for maintaining the IR transmitting window of an interceptor at low temperature so as to minimize background interferences introduced by aerodynamic heating effects is described. The concept involves immersing a nest of fiber optics or bore-holes within a matrix of a low temperature pyrolysis material, a transition metal hydride. These hydrides have the ability to absorb heat at low temperatures through the desorption of H2 molecules and thus behave like low temperature, high energy ablators. Thermal response calculations show that our window concept is viable. The modeling of boundary-layer transition control over seeker windows under situations when the surface of the interceptor remains very cool during atmospheric flight is described. This occurs naturally for our "passive cool window" approach which employs a transition metal hydride to maintain window temperatures near 300 K at typical interceptor heating levels of several hundred watts per square centimeter. Such low surface temperatures provide a passive means of preventing boundary-layer transition from laminar to turbulent flow. A three-dimensional stability code was utilized to demonstrate that high-speed (Mach 15) boundary layers on typical seeker head geometries are stabilized by extreme wall cooling.
DTIC
Interceptors; Aerodynamic Forces; Homing Devices; Boundary Layer Transition; Antimissile Defense

19990019016 Air Force Research Lab., Human Effectiveness Directorate, Brooks AFB, TX USA
Testing and Evaluation of the Therapeutic and High Altitude Low Operating (HALO) Oxygen System Follow-On Operational Test and Evaluation (FOT&E) of the C-17 Aircraft *Final Report, Aug. 1996*
Hade, Edward W.; Hale, Jacqueline D.; Blake, Butch O.; Jun. 1998; 22p; In English
Contract(s)/Grant(s): Proj-7184
Report No.(s): AD-A357946; AFRL-HE-BR-TR-1998-0017; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

HQ AFMC/SG requested FOT&E to quantify the medical capabilities of the C-17 passenger oxygen system to support aeromedical (AE) operations. Specifically, this testing effort was performed to: (1) determine if the therapeutic outlets could provide sufficient flow rates and pressures to support ventilators, (2) determine if the high altitude low opening (HALO) outlets could provide sufficient flow rates and pressures to support medical flow meters, and (3) document the effects of an emergency mask deployment on the HALO/ therapeutic function.
DTIC
Transport Aircraft; Flowmeters; C-17 Aircraft; Oxygen Supply Equipment; Flow Velocity; Aerospace Medicine

19990019043 Massachusetts Inst. of Tech., Lincoln Lab., Lexington, MA USA
Airbus 320 Performance During ATC-Directed Breakouts on Final Approach
Hollister, K. M.; Rhoades, A. S.; Lind, A. T.; Nov. 20, 1998; 121p; In English
Contract(s)/Grant(s): DTFA01-93-Z-02012
Report No.(s): AD-A357828; ATC-265; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

An evaluation of Airbus 320 (A320) performance during ATC-directed breakouts was conducted in a two-part study during 1995. Phase I tested performance given existing pilot training and ATC breakout phraseology. Phase II tested the combined effect of proposed ATC phraseology, pilot situational awareness training, and an A320-specific breakout procedure on performance. Pilot training included a briefing and viewing a videotape, but no simulator practice. Turn performance statistics from the Precision Runway Monitor Demonstration Program were used as the test criteria. Pilot preferences regarding procedures and the training material were also elicited. Three conclusions were: (1) breakout performance given the tested combination of pilot training and proposed ATC phraseology did meet the test criteria; (2) breakout performance given existing procedures did not meet the test criteria; and (3) the tested breakout procedure should be refined because it conflicted with other cockpit procedures and increased the transition time to a positive climb rate. Based on the results of this study, it is recommended that a combination of pilot situational awareness training, A320 breakout procedure, and modified ATC breakout phraseology equivalent to that tested in Phase II be employed for simultaneous parallel approach operations in instrument meteorological conditions.
DTIC
Pilots; Maneuvers; Air Traffic Control; European Airbus; Pilot Training; Flight Tests

19990019057 General Accounting Office, National Security and International Affairs Div., Washington, DC USA
Special Operations Forces: C-130 Upgrade Plan Could Help Fix Electronic Warfare Deficiencies
Nov. 1998; 21p; In English; Report to the Honorable Patrick Kennedy, House of Representatives.
Report No.(s): AD-A357574; GAO/NSIAD-99-1; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In response to a concern that threats to the U.S. Special Operations Command's (USSOCOM) aircraft are increasing, while funds available for electronic warfare are decreasing, the General Accounting Office (GAO) are reviewing USSOCOM'S acquisition strategy for aircraft electronic warfare systems. This report focuses on fixed-wing C-130 aircraft operated by USSOCOM'S

Air Force component, the Air Force Special Operations Command (AFSOC). As requested, GAO determined (1) the soundness of AFSOC's electronic warfare acquisition strategy and (2) the extent to which AFSOC is correcting deficiencies and maximizing commonality in its electronic warfare systems. GAO also identified a funding source that could help AFSOC further implement its electronic warfare acquisition strategy. GAO will address USSOCOM'S rotary-wing aircraft in a separate report. The nation's special operations forces provide the National Command Authorities a highly trained, rapidly deployable joint force capable of conducting special operations anywhere in the world. In November 1986 Congress enacted section 1311 of Public Law 99-661, which directed the President to establish USSOCOM, a unified combatant command to ensure that special operations forces were combat ready and prepared to conduct specified missions. USSOCOM'S component commands include AFSOC, the Army Special Operations Command, the Naval Special Warfare Command and the Joint Special Operations Command. AFSOC, located at Hurlburt Field, Florida, deploys and supports special operations forces worldwide, to ensure that special operations were adequately funded, Congress further provided in section 1311 of Public Law 99-661 that the Department of Defense create for the special operations forces a major force program (MFP) category for the Future Years Defense Plan of the Department of Defense.
DTIC

Electronic Warfare; Electronic Equipment; Transport Aircraft; Aircraft Configurations; C-130 Aircraft; Rotary Wing Aircraft

19990019059 Naval Postgraduate School, Monterey, CA USA
Design and Integration of a Flight Management System for the Unmanned Air Vehicle Frog
Rivers, Timothy C.; Dec. 1998; 110p; In English
Report No.(s): AD-A357572; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The purpose of this thesis is to design, integrate and flight test a Flight Management System (FMS) for the computer control of an unmanned air vehicle (UAV), by combining modern control design techniques and the capabilities of a Rapid Prototyping System (RPS), we were able to safely go from concept to flight test in a relatively short amount of time without sacrificing thoroughness in computer simulation, code validation and verification, or hardware-in-the-loop ground testing. This ability to quickly field new or modified flight control systems for UAV's is of ever increasing importance as Department of Defense places greater emphasis on the use of UAV's in widely varying mission areas. The primary focus of this thesis is on the design and testing of a heading controller. However, to fully integrate this into the FMS, the research and testing includes airspeed and altitude controllers designed by previous thesis students. Also included as part of the implementation process, is a thorough sensor evaluation to ensure the controller inputs are adequate to support the FMS. The design and test equipment include a highly modified FROG UAV from the U.S. Army, the MATRIX Product Family of software tools developed by Integrated Systems, Inc., and a Ground Station built at NPS from commercially available computer and communication equipment.
DTIC

Flight Management Systems; Computerized Simulation; Communication Equipment; Control Systems Design; Altitude Control; Interprocessor Communication; Flight Tests

06
AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices, and flight instruments.

19990019037 Smiths Industries Ltd., London UK
Navy AV-8B Crash Survivable Flight Incident Recorder (CSFIR)
Nov. 23, 1998; 35p; In English
Contract(s)/Grant(s): N00019-98-F-0016
Report No.(s): AD-A357760; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

On 17-18 November 1998, representatives from the Navy, Boeing and Smiths Industries (SI) met at the Naval Air Weapons Development Center, Building P302, China Lake, CA for a Program Review I Technical Interchange Meeting in support of the AV-8B Crash Survivable Flight Incident Recorder System (CSFIR) integration program. Smiths Industries is developing software for its Voice and Data Recorder (VADR) under this contract. A list of attendees is in attachment #1. Attachment #2 lists the resulting action items. The objective of this meeting was to provide an update on this program including the Program Overview, Task Description, Deliverable Items, Schedule, Status of the Interface Control Document, Software Design, System Test Plans, Software Requirement Specification Review. Attachment #3 is a copy of the briefing material.
DTIC

Flight Recorders; Automatic Control; Data Recorders; Harrier Aircraft; Systems Integration; Weapons Development

07
AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

19990018134 United Technologies Research Center, East Hartford, CT USA
Nonlinear Modeling, Analysis, and Control of Turbomachinery Stall Flutter *Final Report, 15 May 1995 - 15 Aug. 1998*
Copeland, George Scott; Rey, Gonzalo; Aug. 14, 1998; 70p; In English
Contract(s)/Grant(s): F49620-95-C-0035
Report No.(s): AD-A355994; AFRL-SR-BL-TR-98-0694; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The linear and nonlinear dynamic behavior of flexibly bladed turbomachines is presented. The analytical description is based on matching a two dimensional, incompressible flow field across a semi-actuator disk representation of a flexible rotor and a rigid stator. The aerodynamic loading on the rotor is derived using control volume formulations applied to discrete blade passages allowing consideration of finite interblade phase angles. Depending on operating parameters, the model exhibits behaviors classified as surge, rotating stall, and stall flutter which are qualitatively consistent with experimentally observed results. The formulation provides a tractable, nonlinear state space description of the dynamics responsible for surge, rotating stall, flutter, and their interaction. An analysis is performed for system parameters representative of a laboratory scale fan test facility. The behavior of the operability limiting instability modes is examined using time simulations, eigenvalue analysis and stability diagrams.
DTIC
Gas Turbines; Flutter; Incompressible Flow; Aerodynamic Stalling; Nonlinear Systems; Two Dimensional Flow; Mathematical Models; Turbomachinery; Dynamic Characteristics

19990018245 Aerospatiale, Aerodynamics Dept., Toulouse, France
Propulsion System Design for the European Supersonic Civil Transport Aircraft
Prat, D., Aerospatiale, France; Nov. 1998; 1p; In English; Also announced as 19990018232; Copyright Waived; Avail: CASI; A01, Hardcopy; A03, Microfiche; Abstract Only; Abstract Only

The three major European aircraft manufacturers have agreed on a common configuration for the future supersonic transport aircraft: the ESCT (European Supersonic Civil Transport aircraft). Daimler-Benz Aerospace, British Aerospace and Aerospatiale are working in close cooperation to make this project a reality. The technical feasibility of the future supersonic aircraft (SCT) depends on critical items such as high temperature materials, noise reduction during take-off, low NOx emissions, wave drag reduction, weight reduction, artificial vision...etc... In order to cope with these items, the European Supersonic Research Program (ESRP) has been established between the three above-mentioned aircraft manufacturers and their related national research establishments (NREs): DLR for Germany, DERA for Great Britain and ONERA for France. Within the ESRP project, aircraft manufacturers not only could work with their related NREs but also with the NREs from the other countries to give a better flexibility to the project. The aim of ESRP is to provide and verify essential technologies for the development of an economically and environmentally viable SCT. Main fields covered within the ESRP are: - Aerodynamics - Propulsion integration - Structure/materials - Systems - Technology integration For each of these fields the major issues are addressed to ensure a full coverage of critical items while avoiding unintended duplication amongst the various partners. Aerodynamics represent 29% of the ESRP activity and if part of the 13.7% contribution from propulsion integration is also included in aerodynamics, it is more than one third of the overall effort that is spent on aerodynamic research for SCT. On the other hand, structure and materials represent 34%, and 16.2% is devoted to the systems. ESCT in supersonic cruise. Moreover, considering that it is a long range aircraft, long overland portions of flight have to be considered. The overland cruise is transonic at Mach=0.95. to cope with this particularity, the ESCT design is optimised both for supersonic and transonic speed. Typical target values for lift-to-drag ratio for these two regimes are: - L/D approximately 9 at supersonic cruise (M=2.0) - L/D approximately 15 at transonic speeds (M=0.95) to achieve these ambitions objectives, every piece of the aircraft design has to be looked into in detail.
Author
Propulsion System Configurations; Aircraft Design; Aerodynamics; Supersonic Transports; Civil Aviation; Transport Aircraft; Aerodynamic Configurations

19990018246 Aerospatiale, Aerodynamic Dept., Toulouse, France
Application of CFD Methods to Propulsion System Integration in the Future Supersonic Transport Aircraft
Prat, D., Aerospatiale, France; Surply, T., Aerospatiale, France; Gisquet, D., Aerospatiale, France; Nov. 1998; 10p; In English; Also announced as 19990018232; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The economic viability of a future supersonic transport aircraft requires ambitious aerodynamic performance. Owing to its large impact on aircraft performance, the aerodynamic design of the future supersonic transport aircraft propulsion system is of utmost importance to Aerospatiale. However, it represents a particularly long and difficult task. The use of new CFD methods proved to be very helpful and powerful in designing the whole propulsion system. Through this process, Aerospatiale has developed know-how on both the internal and the external parts of the propulsion system. Although the internal components of the propulsion system, i.e. the air intake, engine and nozzle have to be studied as a whole, the internal performance of a supersonic air intake is highly dependent on overall aircraft configuration. It therefore requires special care from the aircraft designer in the trade-off between internal performance (pressure recovery and operating characteristics) and external drag. CFD methods, by simulating operating characteristics, provide a tool for better understanding the phenomena involved in flow physics. These tools, associated with overall expertise on intake design, were used to define and test a supersonic air intake. The high level of information provided by modern CFD methods is a key point for both internal and external flow analysis. The code used by Aerospatiale was developed in cooperation with ONERA. It includes Euler and Navier-Stokes solvers with space marching and Parabolized Navier-Stokes capabilities for fully supersonic flows. These last two capabilities allow complex industrial geometries to be studied while drastically reducing computing time. Considering the ability of the code to represent accurate physical phenomena, its Euler, as well as PNS and full Navier-Stokes capabilities, were used in the whole propulsion system integration process. The external design of nacelles results from a careful analysis of the flow pattern on the wing's lower surface. A proposed geometry is obtained by minimizing the total drag while considering local flow conditions and the strong aerodynamic interactions of the nacelles. The various levels of modelling of the CFD code provide an appropriate cost-effective answer to each type of physical phenomenon found in the flow pattern around the nacelles. This capability is essential for defining the best trade-off in the aerodynamic design of the propulsion integration. Experimental data are presented confirming the overall design process.
Author

Propulsion System Configurations; Supersonic Transports; Transport Aircraft; Aerodynamics; Aircraft Configurations; Aerodynamic Configurations; Computational Fluid Dynamics

19990018286 Air Force Research Lab., Propulsion Directorate, Wright-Patterson AFB, OH USA

Fundamental Investigations of an Integrated Fuel Injector/Flameholder Concept for Supersonic Combustion *Final Report, May 1996 - Sep. 1998*

Gruber, Mark R.; Sep. 1998; 58p; In English

Contracts/Grants(s): Proj-2300

Report No.(s): AD-A356336; AFRL-PR-WP-TR-1998-2111; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report describes the results of a recent series of experiments designed to examine the fundamental behavior of several cavity-based flameholder candidates in a non-reacting supersonic flow. Seven geometries were tested in conjunction with a new facility nozzle. Results indicate that the cavity aft ramp plays a strong role in determining the character of the shear layer which spans the length of the cavity. For rectangular cavities, a compression wave forms as the flow separates from the upstream corner of the cavity. Thus, the pressure on the upstream face increases above the freestream value. In these cases, the recompression which occurs at the aft wall is very sharp with strong pressure gradients at the axial location corresponding to the aft wall. These cases are also visibly unsteady. Reductions in the ramp angle yield more stable, two-dimensional flowfields. However, the character of the separation wave changes gradually from compressive to expansive as the ramp angle is reduced. As such, the shear layer tends to dip into the cavity and the recompression occurs more gradually as the shear layer reattaches to the aft wall. Changes in cavity offset ratio result in more dramatic changes in the cavity flowfield. The separation wave becomes strongly expansive leading to severe shear layer intrusion into the cavity. Aft wall changes do not strongly impact the character of the shear layer, although stability is enhanced and recompression is more gradual for shallower ramp angles.
DTIC

Fuel Injection; Flame Holders; Systems Integration; Supersonic Combustion; Compression Waves; Free Flow; Reacting Flow

19990018622 Maryland Univ., Dept. of Mechanical Engineering, College Park, MD USA

A Second Generation of Backstepping Designs and Robust Nonlinear Control of Aeroengines *Final Report, 1 Jun. 1996 - 17 Aug. 1997*

Krstic, Miroslav; Aug. 1997; 13p; In English

Contracts/Grants(s): F49620-96-1-0223

Report No.(s): AD-A356727; AFRL-SR-BL-TR-98-0828; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The objective of this research has been twofold: (1) to develop nonlinear control design techniques that can systematically accommodate nonlinearities and have optimality properties, and (2) develop control methods for robust stabilization and optimization of performance of aeroengine compressor systems.
DTIC
Control Theory; Nonlinear Systems; Aircraft Engines; Control Systems Design

19990018683 California Univ., Dept. of Mechanical and Environmental Engineering, Santa Barbara, CA USA
Dynamics and Control of Infinite-Dimensional Models of Jet Engine Compression Systems *Final Report, 1 May 1997 - 31 Dec. 1997*
Mezic, Igor; Aug. 20, 1998; 9p; In English
Contract(s)/Grant(s): F49620-97-1-0293
Report No.(s): AD-A356887; AFRL-SR-BL-TR-98-0832; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The objective of this project was to study dynamics and control of jet engine compression systems within the new framework that we have developed for the infinite dimensional Moore Greitzer model. In this framework, the Moore Greitzer model of compressor dynamics was reformulated as a set of nonlinear evolution equations (one partial differential equation, and two ordinary differential equations). We designed control laws for the infinite dimensional Moore Greitzer model that can be truncated to finite dimensional laws for the purpose of implementation. Finite dimensionality is thus not a control architecture issue but an implementation issue. Stability and dynamics of stall cells was investigated numerically and analytically within the new framework. We have investigated the Moore Greitzer model in cases when the number of stages is not very large. We have shown that the solution in this case is still a travelling wave that travels around the annulus with the speed that is equal to S1/2S of the rotor speed. We have also shown that there are no other travelling wave solutions, i.e. the stall cell can not travel at any other speed. We have developed a large scale, averaged model that reduces to the Moore Greitzer model in a certain limit and investigated its properties. The model is based on measurable quantities and thus avoids the problem of having the phenomenological compressor characteristic as one of the assumptions. Based on symmetry considerations, we have shown that the assumption of Moore and Greitzer that the disturbance travels through the compressor is indeed valid rigorously in the asymptotic limit where the rotational effects due to rotors dominate the compressor dynamics.
DTIC
Jet Engines; Stalling; Turbocompressors

08
AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities, piloting, flight controls, and autopilots

19990017809 Defence Evaluation Research Agency, High Speed and Weapon Aerodynamics Dept., Bedford, UK
Lattice Controls: A Comparison With Conventional, Planar Fins
Simpson, G. M., Defence Evaluation Research Agency, UK; Sadler, A. J., Defence Evaluation Research Agency, UK; Nov. 1998; 10p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This analysis of the DERA lattice controls data has centered on a comparison between the lattice controls and conventional, planar controls which were the subject of previous research. All types of control surface studied were mounted as tail controls. The comparisons were justified on the basis of equal longitudinal stability imparted to the body at zero incidence. The vertical lattice controls of a cruciform set were found to impart a significant proportion of the static stability, but to contribute nothing to the control effectiveness. Other characteristics of lattice controls are small hinge moments with low centre of pressure variation with Mach number and incidence, increased yaw stability at incidence, reduced effect of vortex interaction and, at lower supersonic speeds, lower configuration drag at high angle of attack than equivalent conventional configurations. However, the particular lattice control designs studied here were found to exhibit reduced control effectiveness at high combined incidence and deflection.
Author
Missiles; Missile Configurations; Missile Design; Supersonic Speed; Longitudinal Stability; Static Stability; Control Surfaces; Fins; Missile Control

19990017829 Army Research Lab., Aerodynamics Branch, Aberdeen Proving Ground, MD USA
Prediction of Pitch-Damping for Symmetric Missiles
Weinacht, Paul, Army Research Lab., USA; Nov. 1998; 12p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

An approach for predicting the pitch-damping performance of symmetric missiles is presented. Several types of forced motions are utilized to excite the aerodynamic forces and moments that are normally associated with unsteady motion. A key feature of these motions is that steady flow fields are produced by the selected motions. Flow field predictions are accomplished using Navier-Stokes computational techniques that make use of a noninertial rotating coordinate frame resulting from the imposed motions. The aerodynamic forces and moments are then determined from the computed flow field. Applications of the method presented in this paper include predictions of the pitch-damping sum for axisymmetric projectiles at high subsonic, transonic, and supersonic velocities and prediction of the pitch-damping sum for finned projectiles at supersonic velocities. The method is also applied to determine the individual components of the pitch-damping sum for axisymmetric and finned flight bodies.
Author
Missiles; Missile Configurations; Aerodynamic Forces; Stability Derivatives; Axisymmetric Bodies; Finned Bodies; Navier-Stokes Equation; Projectiles; Steady Flow; Dynamic Stability; Damping

19990017831 Combustion Research and Flow Technology, Inc., Dublin, PA USA
Advances in Missile Aeropropulsive Flowfield Simulation
Dash, S. M., Combustion Research and Flow Technology, Inc., USA; Walker, B. J., Army Aviation and Missile Command, USA; Nov. 1998; 14p; In English; Also announced as 19990017801
Report No.(s): Paper 31; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper summarizes advances made in Navier-Stokes predictive methodology for missile aeropropulsive flowfields implementing both structured and unstructured grid numerics. Future missile systems will be relying on varied forms of jet interaction control for enhanced maneuverability. The simulation of jet/aerodynamic interactions entails dealing with solid-propellant thermochemical and multi-phase flow issues as an integral part of the missile aerodynamic solution. Thrust amplification can be affected by both afterburning and by gas/particulate interactions. Turbulence modeling requires many advances not needed for conventional missile aerodynamic predictions. This paper will address the systematic upgrade and validation of structured and unstructured grid Navier-Stokes codes (CRAFT and CRUNCH) to deal with such aeropropulsive interactions. Another topic to be discussed is the treatment of cavity aeroacoustics and store dispense. Recent studies have highlighted the need to utilize a large eddy simulation (LES) framework to correctly predict the magnitude and spectral characteristics of cavity pressure-oscillations. Inclusion of varied grid-movement capabilities into a multiple-domain variant of the CRUNCH code permits it to analyze multi-body flows, with flux interfacing at domain boundaries providing improvements in accuracy over overset (Chimera) methods, particularly for closely spaced bodies where viscous effects strongly influence the aerodynamic coefficients. This new approach is being applied to submunition dispense, stage/booster separation, sensor window shroud removal, and related problems.
Author
Missiles; Computational Fluid Dynamics; Computerized Simulation; Flow Distribution; Propulsion; Missile Systems; Multiphase Flow; Navier-Stokes Equation; Structured Grids (Mathematics); Unstructured Grids (Mathematics); Viscous Flow; Applications Programs (Computers); Jet Control; Missile Control; Aeroacoustics

19990018418 Nichols Research Corp., Huntsville, AL USA
Elimination of the Roll Bias Caused by Wrap Around Fins for the FMTI Missile
McKerley, C. W.; Jan. 1998; 6p; In English
Report No.(s): AD-A356532; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The Future Missile Technology Integration (FMTI) Missile System is an attempt to design an Army tactical weapon that can effectively attack both fixed and rotary wing aircraft and armor of all types. Several 6-DOF simulations have been developed to aide in the design of this system. There is a design 6-DOF, a man in the loop (MITLS) simulation, a hardware in the loop (HWIL) simulation, and a tracker design simulation to name a few. The design 6-DOF is the highest fidelity simulation and it has been used as input to the other simulations. The design simulation is used to design the overall system requirements including hardware and software algorithms. As to be expected, the design 6-DOF has gone through many changes as the system evolved. It has become apparent that there has been a roll angle bias introduced into the roll channel of the missile. The source of this roll bias is discussed in this paper and a design is introduced to effectively eliminate or minimize its effect.
DTIC
Aerodynamic Stability; Computerized Simulation; Aircraft Configurations; Missile Systems; Algorithms

19990018600 NASA Lewis Research Center, Cleveland, OH USA
Investigation of Dynamic Flight Maneuvers With an Iced Tailplane
VanZante, Judith Foss, DYNACS Engineering Co., Inc., USA; Ratvasky, Thomas P., NASA Lewis Research Center, USA; January 1999; 14p; In English; 37th; Aerospace Sciences, 11-14 Jan. 1999, Reno, NV, USA; Sponsored by American Inst. of Aero-

nautics and Astronautics, USA
Contract(s)/Grant(s): NAS3-9808; RTOP 548-20-23
Report No.(s): NASA/TM-1999-208849; E-11470; NAS 1.15:208849; AIAA Paper 99-0371; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A detailed analysis of two of the dynamic maneuvers, the pushover and elevator doublet, from the NASA/FAA Tailplane Icing Program are discussed. For this series of flight tests, artificial ice shapes were attached to the leading edge of the horizontal stabilizer of the NASA Lewis Research Center icing aircraft, a DHC-6 Twin Otter. The purpose of these tests was to learn more about ice-contaminated tailplane stall (ICTS), the known cause of 16 accidents resulting in 139 fatalities. The pushover has been employed by the FAA, JAA and Transport Canada for tailplane icing certification. This research analyzes the pushover and reports on the maneuver performance degradation due to ice shape severity and flap deflection. A repeatability analysis suggests tolerances for meeting the required targets of the maneuver. A second maneuver, the elevator doublet, is also studied.
Author
De Havilland Aircraft; Horizontal Tail Surfaces; Flapping; Aircraft Icing; Flight Hazards; Flight Tests; Aircraft Maneuvers

19990018654 George Washington Univ., Joint Inst. for Advancement of Flight Sciences, Hampton, VA USA
Analysis of Wind Tunnel Oscillatory Data of the X-31A Aircraft
Smith, Mark S., George Washington Univ., USA; February 1999; 126p; In English
Contract(s)/Grant(s): NCC1-24; RTOP 522-25-21-07
Report No.(s): NASA/CR-1999-208725; NAS 1.26:208725; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Wind tunnel oscillatory tests in pitch, roll, and yaw were performed on a 19%-scale model of the X-31A aircraft. These tests were used to study the aerodynamic characteristics of the X-31A in response to harmonic oscillations at six frequencies. In-phase and out-of-phase components of the aerodynamic coefficients were obtained over a range of angles of attack from 0 to 90 deg. To account for the effect of frequency on the data, mathematical models with unsteady terms were formulated by use of two different indicial functions. Data from a reduced set of frequencies were used to estimate model parameters, including steady-state static and dynamic stability derivatives. Both models showed good prediction capability and the ability to accurately fit the measured data. Estimated static stability derivatives compared well with those obtained from static wind tunnel tests. The roll and yaw rate derivative estimates were compared with rotary-balanced wind tunnel data and theoretical predictions. The estimates and theoretical predictions were in agreement at small angles of attack. The rotary-balance data showed, in general, acceptable agreement with the steady-state derivative estimates.
Author
X-31 Aircraft; Aerodynamic Characteristics; Harmonic Oscillation; Wind Tunnel Tests; Dynamic Stability; Scale Models; Static Stability; Unsteady Aerodynamics; Mathematical Models

19990018690 Air Force Research Lab., Munitions Directorate, Eglin AFB, FL USA
Adaptive Nonlinear Autopilot for Anti-Air Missiles
McFarland, Michael B.; Stansbery, Donald T.; Jan. 1998; 8p; In English; Prepared in collaboration with QuesTech, Niceville, FL.
Report No.(s): AD-A356503; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The prevalent method of synthesizing nonlinear missile autopilots is by gain-scheduling linear designs. Although this approach has proven successful in numerous applications, the desire to continually improve performance without incurring additional cost suggests the need for a new design paradigm. An opportunity to address this need has been identified from previous research which employed neural network technology to augment approximate dynamic inversion controllers. In the one architecture a neural network adaptively cancels linearization errors through on-line learning, which may be accomplished by a weight update rule derived from Lyapunov theory. This effectively guarantees stability of the closed-loop system. This paper concerns a similar implementation in which neural networks function instead to improve command tracking of gain-scheduled control laws. This theoretical development is then specialized to the problem of synthesizing a bank-to-turn autopilot for an agile anti-air missile. Finally, the resulting hybrid control law is demonstrated in a nonlinear simulation and its performance is evaluated relative to that of the unaugmented gain-scheduled autopilot.
DTIC
Automatic Pilots; Control Theory; Controllers; Feedback Control; Missiles; Control

09
RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

19990018141 Air Force Research Lab., Munitions Directorate, Eglin AFB, FL USA
Recent Technology Developments for the Kinetic Kill Vehicle Hardware-In-The-Loop Simulator (KHILS)
Murrer, Robert L., Jr.; Thompson, Rhoe A.; Coker, Charles F.; Jan. 1998; 16p; In English
Report No.(s): AD-A355943; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The KHILS facility has been under development since 1986 to provide the BMDO with an independent government owned, national test resource for the accomplishment of nondestructive performance testing of precision guided missile systems and subsystems. KHILS' IOC in 1988 demonstrated a LCLV driven by videotape for SBI testing. Over the last 10 years, KHILS has continually pushed the state-of-the-art of HWIL technologies. In recent testing KHILS has demonstrated closed-loop operations with high fidelity phenomenology models hosted on a 3-D all-aspect scene generation computer whose output drove a large format resistor array augmented by a laser source projector system. Development and refinement of the resistor array projectors is being addressed with the WISP and MSSP programs. A low background test chamber is being brought on line to support HWIL testing of sensors requiring low temperature background environments. Advanced development has begun on 1024 x 1024 high-speed resistor array projection devices and a 5-axis flight motion simulator.
DTIC
Nondestructive Tests; Projectors; Missile Systems; Feedback Control; Flight Simulators; Low Temperature Environments

19990018208 Office National d'Etudes et de Recherches Aerospatiales, Paris, France
MERIC (Moyen Experimental pour la Reconnaissance et l'Identification des Cibles): Recent Developments
Brouard, P., Office National d'Etudes et de Recherches Aerospatiales, France; Attia, S., Office National d'Etudes et de Recherches Aerospatiales, France; Guern, R., Office National d'Etudes et de Recherches Aerospatiales, France; Nov. 1998; 8p; In French; Also announced as 19990018200; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

In this paper we present some recent technological developments in a ground based radar station named MERIC. We describe the X band polarimetric radar and some of its applications: (1) simultaneous measurement of the four terms of the polarimetric backscattering matrix; (2) study of wide band coherent waveform (up to 300 MHz); and (3) HRR measurements and 2 D Imaging. Some results obtained on cooperative aircraft are presented. We also describe the "state of the art" in the development of a bistatic Ku band radar which should be operational in the mid of 1998.
Author (revised)
Technology Assessment; Procedures; Ground Stations; Radar

19990018577 Naval Postgraduate School, Monterey, CA USA
Helicopter Terrain Navigation Training Using a Wide Field of View Desktop Virtual Environment
Sullivan, Joseph A.; Sep. 1998; 121p; In English
Report No.(s): AD-A356059; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Helicopter terrain navigation is a unique task; training for this task presents unique challenges. Current training methods rely on dated technology and inadequately prepare pilots for real world missions. Improved training specifically tailored to address the unique needs of the helicopter community that capitalizes on recent improvements in desktop virtual environment (VE) technology could substantially improve the training process and reduce training costs. Based on the input of subject matter experts in current helicopter terrain navigation training techniques and VE technology, such a system was developed and tested on student pilots performing real world tasks. A desktop VE that presented a simple to control and learn, interactive fly though of a terrain model was used to augment conventional training at Helicopter Antisubmarine Squadron Ten (HS-10). Results indicate that flight time for students that received VE training was more productive than for students that received conventional training. This work justifies the next logical step; fielding a system on a long term basis as a squadron asset. This system would provide improved training for the helicopter community and an invaluable source of research data for the Naval Postgraduate School.
DTIC
Flight Training; Helicopters; Virtual Reality; Air Navigation; Flight Simulation; Antisubmarine Warfare; Head-Up Displays

19990018588 Federal Aviation Administration, Technical Center, Atlantic City, NJ USA
Final Phase Runway Visual Range (RVR)/Automated Surface Observing System (ASOS) Interface Operational Test and Evaluation (OT&E) Report
Benner, William; Carty, Thomas; McKinney, Michael; Jones, Micheal; Sep. 1998; 94p; In English
Report No.(s): AD-A356974; DOT/FAA/CT-TN98/18; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report summarizes results of Operational Test and Evaluation (OT&E) performed on the Final Phase Runway Visual Range (RVR) Automated Surface Observing System (ASOS) Interface. Testing was conducted from June 23 through 27, 1997, at Memphis International Airport (MEM). This test effort follows two OT&E sessions for the Interim Phase RVR/ASOS Interface at MEM during October 1996, and January 1997. Refer to document DOT/FAA/CT-TN97/14 for results of OT&E on the Interim RVR/ASOS Interface. The purpose of OT&E was to verify adherence to requirements as stated in Interface Control Document (ICD) 50-SANW-1-0050 and determine the operational effectiveness and suitability of the interface within the National Airspace System (NAS). OT&E activities resulted in the observance of 20 problems documented as Test Trouble Reports (TTR). of the identified problems, 3 related to New Generation RVR system operation, 7 related to ASOS performance, and 10 were associated with RVR installation and instruction documentation. Initial analysis indicates problems relating to RVR system operation will have a minimal, if any, impact on New Generation RVR/ASOS Interface performance. OT&E resulted in no problems directly relating to New Generation RVR/ASOS Interface operation. As a result, ACT-320 recommends deployment of the interface after the successful completion and passing of remote maintenance monitoring tests.
DTIC
Visibility; Runways; National Airspace System; System Effectiveness; Deployment; Airports

19990018589 Federal Aviation Administration, William J. Hughes Technical Center, Atlantic City, NJ USA
Runway Visual Range (RVR) Automated Surface Observing System (ASOS) Functional Test Report
Benner, William; McKinney, Michael; Jones, Michael; Sep. 1998; 37p; In English; Prepared in collaboration with Raytheon Service Co., Pleasantville, NJ.
Report No.(s): AD-A356995; DOT/FAA/CT-TN98/19; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Runway Visual Range (RVR) Automated Surface Observing System (ASOS) functions were evaluated during tests conducted at Memphis International Airport (MEM) from April 14 through 16, 1998. Representatives from the Federal Aviation Administration (FAA) William J. Hughes Technical Center Weather Communication Branch performed the testing. Testing was initiated in response to ASOS software modifications which contained corrections to problems existing on earlier versions. The primary intent of testing was to verify that RVR ASOS functions operated in accordance with requirements and to determine if problems could be expected during operation with the Interim and Final Phase New Generation RVR/ASOS Interface. Five performance issues were encountered during testing. Four issues concerned ASOS performance and one related to operation of the HP Palmtop PC, i.e., Interim RVR/ASOS Interface. Since all of these issues currently have "work-arounds" or established methods to avoid/correct the problem, they are not expected to adversely affect Long-Line RVR service. As a result, ACT-320 recommends use of ASOS software version 2.53 at sites designated for Long-Line RVR reporting with the Interim or Final Phase RVR/ASOS Interface.
DTIC
Airport Towers; Runways; Airports; Air Traffic Control

19990018590 Army Construction Engineering Research Lab., Champaign, IL USA
Seismic Evaluation of the Type L and San Luis Obispo Braced Frame FAA Airport Traffic Control Towers *Final Report*
Wilcoski, James; Heymsfield, Ernest; Horne, James; Manning, George; Walters, Matthew; Nov. 1998; 320p; In English
Report No.(s): AD-A357002; No Copyright; Avail: CASI; A14, Hardcopy; A03, Microfiche

Executive Order (EO) 12941 requires all Federal agencies to develop and submit "seismic upgrade" cost estimates to the Federal Emergency Management Agency no later than 1 December 1998. The U.S. Army Corps of Engineers assisted the Federal Aviation Administration (FAA) in responding to this EO by evaluating the seismic resistance of many of their facilities. This report presents a detailed seismic evaluation of the FAA's Airport Traffic Control Towers in Salinas, San Carlos, Palo Alto, and San Luis Obispo, CA.
DTIC
Earthquake Resistant Structures; Air Traffic Control; Airport Towers; Structural Design

19990018770 NYMA, Inc., Brook Park, OH USA

Flow Quality Measurements in an Aerodynamic Model of NASA Lewis' Icing Research Tunnel *Final Report*

Camacci, Victor A., NYMA, Inc., USA; Gonsalez, Jose C., NYMA, Inc., USA; Jan. 1999; 22p; In English; 31st; Joint Propulsion, 10-12 Jul. 1995, San Diego, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): NAS3-27186; RTOP 523-91-13

Report No.(s): NASA/CR-1999-202353; E-10790; NAS 1.26:202353; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

As part of an ongoing effort to improve the aerodynamic flow characteristics of the Icing Research Tunnel (IRT), a modular scale model of the facility was fabricated. This 1/10th-scale model was used to gain further understanding of the flow characteristics in the IRT. The model was outfitted with instrumentation and data acquisition systems to determine pressures, velocities, and flow angles in the settling chamber and test section. Parametric flow quality studies involving the insertion and removal of a model of the IRT's distinctive heat exchanger (cooler) and/or of a honeycomb in the settling chamber were performed. These experiments illustrate the resulting improvement or degradation in flow quality.

Author

Test Chambers; Wind Tunnels; Flow Characteristics; Scale Models; Ice Formation; Flow Measurement

19990018828 NYMA, Inc., Brook Park, OH USA

Flow Field Surveys of the NASA Lewis Research Center 8- by 6-Foot Supersonic Wind Tunnel (1993 Test) *Final Report*

Arrington, E. Allen, NYMA, Inc., USA; December 1998; 40p; In English

Contract(s)/Grant(s): NAS3-27186; RTOP 523-91-13

Report No.(s): NASA /CR-1998-206610; NAS 1.26:206610; E-11146; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An abbreviated program was conducted in the NASA Lewis Research Center 8- by 6-Foot Supersonic Wind Tunnel to calibrate the test section and survey the flow quality following the installation of flow quality improvements in the facility. This program was designed to accommodate the specific requirements of an aeropropulsion research test program that took place before a complete test section calibration was conducted. Therefore, the flow quality goals for the 8- by 6-ft test section were based on the specific requirements of the research program and the facility's operational constraints. Test results indicate that flow quality in the test section was good and met or exceeded the agreed-upon goals at all except the Mach 2 setting.

Author

Supersonic Wind Tunnels; Wind Tunnel Tests; Calibrating

19990019008 Lockheed Martin Corp., Lockheed Martin Information Systems, Orlando, FL USA

Advanced Distributed Simulation Technology II (ADST II) .Aviation Reconfigurable Manned Simulator Test Cell Proof of Principle CDRL AB01: System Description

Feb. 16, 1998; 76p; In English

Contract(s)/Grant(s): N61339-96-D-0002

Report No.(s): AD-A358111; ADST-II-CDRL-033R-96000411B; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This System Description provides a summary of the principle elements of the Aviation Reconfigurable Manned Simulator Test Cell (ARMS-TC) Proof of Principle device. The device was used as an evaluation tool in assessing fidelity requirements for an aviation element collective task trainer. The device can be configured as an UH-60 Blackhawk, OH-58D Kiowa Warrior, or an AH-64A Apache. The visual system is based on a Silicon Graphics, Inc. Infinite Reality image generator and includes both out the window monitors and a helmet mounted display capability. In addition, the visuals included head down and night vision goggle sensor views. The system includes nine personal computers as the computational capability. It also includes a control loading system to provide trim and pilot feel feedback. An aural cue system is used to provide sound and seat vibration cues for pilot stimulation. A digital radio communication system capability is included. The device is certified as DIS 2.04 compliant.

DTIC

Computer Systems Performance; Flight Training; Distributed Interactive Simulation; Systems Simulation

10
ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

19990018442 NASA Langley Research Center, Hampton,VA USA
Aerothermodynamic Calculations on X-34 at Mach 6 Wind Tunnel Conditions
Wood, William A., NASA Langley Research Center, USA; Feb. 1999; 26p; In English
Contract(s)/Grant(s): RTOP 242-80-01-01
Report No.(s): NASA/TM-1999-208998; NAS 1.15:208998; L-17794; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The effects of Reynolds number and turbulence on surface heat-transfer rates are numerically investigated for a 0.015 scale X-34 vehicle at wind tunnel conditions. Laminar heating rates, non-dimensionalized by Fay-Riddell stagnation heating, do not change appreciably with an order of magnitude variation in Reynolds number. Modeling a turbulent versus laminar boundary layer at the same Reynolds number increases the windside heating by a factor of four, portions on the leeside by a factor of two, and causes a 30 percent increase in wing leading edge heating. A discrepancy between laminar and turbulent heating trends on the windside centerline is explained by the presence of attached windside vortices in the laminar solutions, structures that are inhibited by the turbulence modeling.
Author
X-34 ReUSAble Launch Vehicle; Wind Tunnel Tests; Laminar Boundary Layer; Hypersonic Heat Transfer; Reynolds Number; Turbulence Effects; Aerothermodynamics; Turbulent Boundary Layer; Baldwin-Lomax Turbulence Model; Aerodynamic Heating

11
CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

19990017989 NASA Langley Research Center, Hampton, VA USA
Methodology for Predicting the Onset of Widespread Fatigue Damage in Lap-Splice Joints
Newman, J. C., Jr., NASA Langley Research Center, USA; Harris, C. E., NASA Langley Research Center, USA; Piascik, R. S., NASA Langley Research Center, USA; Dawicke, D. S., NASA Langley Research Center, USA; Dec. 1998; 20p; In English
Contract(s)/Grant(s): RTOP 522-18-11-01
Report No.(s): NASA/TM-1998-208975; NAS 1.15:208975; L-17799; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

NASA has conducted an Airframe Structural Integrity Program to develop the methodology to predict the onset of wide-spread fatigue damage to lap-splice joints of fuselage structures. Several stress analysis codes have been developed or enhanced to analyze the lap-splice-joint configuration. Fatigue lives in lap-splice-joint specimens and fatigue-crack growth in a structural fatigue test article agreed well with calculations from small-crack theory and crack growth analyses with the FASTRAN code. Residual-strength analyses of laboratory specimens and wide stiffened panels were predicted quite well from the critical crack-tip-opening angle (CTOA) fracture criterion and elastic-plastic finite-element analyses (two- or three-dimensional codes and the STAGS shell code).
Author
Crack Propagation; Crack Tips; Airframes; Stress Analysis; Lap Joints; Fuselages; Finite Element Method; Fatigue Tests; Fatigue (Materials)

19990018536 Naval Medical Research Inst., Toxicology Detatchment, Wright-Patterson AFB, OH USA
Performance Degradation: Is It Important for the Assessment of Toxicants? An Example Using Jet Fuel
Nordholm, A. F., Naval Medical Research Inst., USA; Ritchie, G. D., Naval Medical Research Inst., USA; Rossi, J., III, Naval Medical Research Inst., USA; Still, K. R., Naval Medical Research Inst., USA; The 1998 JANNAF Propellant Development & Characterization Subcommittee and Safety & Environmental Protection Subcommittee Joint Meeting; Apr. 1998;

Volume 1, pp. 437–448; In English; Also announced as 19990018506; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC, Hardcopy, Microfiche

The intent of this paper is to provide sufficient information to allow the reader to recognize the need for neurobehavioral analysis of possible deficits in human performance capacity associated with exposure to chemical toxicants, and to understand the role of neurobehavioral toxicity evaluation in the Military Deployment Toxicology Assessment Program. A recent study of the effects of repeated exposure of rats to jet fuel vapor is summarized to demonstrate the use of laboratory animals to model possible human neurobehavioral performance degradation in operational military deployment scenarios.

Author

Toxicology; Jet Engine Fuels; Human Performance; Mental Performance; Human Behavior; Physiological Effects; Toxic Hazards

19990018768 Naval Postgraduate School, Monterey, CA USA

Investigation of Pressure and Temperature Sensitivities of a Pressure Sensitive Paint

Baumann, Peter D.; Sep. 1998; 104p; In English

Report No.(s): AD-A356858; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

In the development of a surface pressure measurement system for transonic compressor rotors, it has been shown that Pressure Sensitive Paint (PSP) is also temperature dependent. In the present study, the sensitivities to pressure and temperature were examined experimentally using an electronically-gated, intensified Charged- Coupled-Device (CCD) video camera, frame-grabber software and an eight-inch diameter calibration chamber. Using a signal generator, in a procedure that matched the requirements of the rotor application, multiple low-intensity-level camera exposures were integrated and captured to produce a single USAble image. Ten captured images were averaged to increase the image's signal-to-noise ratio and the result was used to produce an image ratio with respect to a static (ambient pressure/temperature) reference condition. Calibration tests of constant temperature/variable pressure and constant pressure/variable temperature were completed. The results were then compared with data obtained using the same paint and an automated, single-exposure calibration procedure at NASA Ames Research Center. It was shown that the calibration data could be used to derive the static pressure field produced over a high-speed test rotor using PSP and the same image-capture system used in the calibration. In preparation for a bench test of the procedure, a uniform-stress, high-speed test rotor disk, fitted with a shock generator was driven at speeds in excess of 30,000 RPM. Recommendations are made toward the goal of obtaining quantitative pressure measurements on transonic compressor rotors.

DTIC

Pressure Measurement; Paints; Temperature Dependence; Transonic Compressors; Pressure Distribution

12
ENGINEERING

Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

19990017832 Matra BAe Dynamics, Flight Dynamics Dept., Velizy-Villacoublay, France

Industrial Use of CFD for Missile Studies: New Trends at MATRA BAe DYNAMICS France

Bredif, Marc, Matra BAe Dynamics, France; Chapin, Florence, Matra BAe Dynamics, France; Borel, Christian, Matra BAe Dynamics, France; Simon, Philippe, Matra BAe Dynamics, France; Missile Aerodynamics; Nov. 1998; 14p; In English; Also announced as 19990017801; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper describes the industrial use of CFD tools at MATRA BAe DYNAMICS France. Recent applications are presented that show the versatility and the potentiality of the AEROLOG software; they concern the simulation of multispecies flows and complex flows. The complementarity between CFD and experiments is illustrated by examples dealing with jet flows, high pressure internal flows, non uniform flow aerodynamics, and missile release trajectory predictions. Work in progress about aeroelastic computations is depicted; the interest of code parallelisation is emphasized. Finally, our point of view is given about the Navier-Stokes approach for missile computations.

Author

Missiles; Aerodynamics; Missile Design; Computational Fluid Dynamics; Computerized Simulation; Missile Trajectories; Navier-Stokes Equation; Aeroelasticity; Applications Programs (Computers)

19990017986 Cleveland State Univ., Cleveland, OH USA

Design Protocols and Analytical Strategies that Incorporate Structural Reliability Models *Final Report, 1 Sep. 1993 - 31 Aug. 1995*

Duffy, Stephen F., Cleveland State Univ., USA; 1995; 14p; In English

Contract(s)/Grant(s): NCC3-310

Report No.(s): NASA/CR-1995-208228; NAS 1.26:208228; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The general goal of this project is to establish design protocols that enable the engineer to analyze and predict certain types of behavior in ceramic composites. Sections of the final report addresses the following: Description of the Problem that Motivated the Technology Development, Description of the New Technology that was Developed, Unique and Novel Features of the Technology and Results/Benefits of Application (year by year accomplishments), and Utilization of New Technology in Non-Aerospace Applications. Activities for this reporting period included the development of a design analysis as part of a cooperative agreement with general Electric Aircraft Engines. The effort focused on modifying the Toughened Ceramics Analysis and Reliability Evaluation of Structures (TCARES) algorithm for use in the design of engine components fabricated from NiAl. Other activities related to the development of an ASTM standard practice for estimating Weibull parameters. The standard focuses on the evaluation and reporting of uniaxial strength data, and the estimation of probability distribution parameters for ceramics which fail in a brittle fashion.

Derived from text

Ceramic Matrix Composites; Gas Turbine Engines; Reliability Analysis; Fiber Composites; Structural Reliability; Engine Parts

19990018142 Naval Postgraduate School, Monterey, CA USA

Refractive Condition in the Caribbean Sea and Its Effects on Radar Systems

Seijas, Douglas F.; Sep. 1998; 82p; In English

Report No.(s): AD-A355956; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Vertical gradients of pressure, temperature and humidity of the troposphere exert a strong influence over propagation of VHF, UHF, and SHF frequencies. These frequencies are associated with aircraft communications, radars and satellite communications, so it is important in military operations to collect precise and timely data from atmospheric conditions. In this thesis programs from EKEPS were used to assess refractive conditions in the Caribbean Sea against selected radar systems. Data given by SDS from radiosonde stations located in MS 43 and 44 were used as input for COVER and PROPR programs. Outputs from COVER are analyzed to find Optimal Altitude to Avoid Detection (OAAD) for a low-flying target. Outputs from PKOPR using climatological data given by SDS and Optimal Altitude to Avoid Detection from COVER was used to verify (OAAD) against selected land- and ship-mounted radars operating in the Caribbean Sea. Finally, a system under development, TDROP is introduced in response to requirements for timely and exact data collection, in order to enhance the tactical data collection process.

DTIC

Radar Equipment; Refraction; Aircraft Communication; Caribbean Sea; Meteorology; Radiosondes

19990018220 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. for Radio Frequency Technology, Wessling, Germany

RCS Determination for DLR Stealth Design F7

Kemptner, E., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Klement, D., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Wagner, H., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Nov. 1998; 12p; In English; Also announced as 19990018200; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The paper presents the current state of work at DLR to analyse a generic airplane design with stealth characteristics using theoretical and experimental tools. The theories implemented in the computer codes and the measurement facilities are described. The procedures to produce scale models are discussed. The results of a mono- and bistatic analysis over a wide frequency band are presented. In addition, implications for the detection probability and an analysis of the target fluctuations relevant for radar detection are shown. The steps pursued in further investigations are outlined.

Author

Radar Cross Sections; Detection; Computer Programs; Targets; Scale Models; Probability Theory; Aircraft Design

19990018221 Daimler-Benz Aerospace A.G., Military Aircraft, Bremen, Germany

Radar Measurements on Scaled Models

Kruse, Juergen, Daimler-Benz Aerospace A.G., Germany; Hochmann, Manfred, Daimler-Benz Aerospace A.G., Germany; Bringmann, Dirk, Daimler-Benz Aerospace A.G., Germany; Nov. 1998; 10p; In English; Also announced as 19990018200; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Within the scope of the development of military aircraft with reduced radar cross section (stealth), radar signature measurements on scaled models play an important part. Their significance can be compared to that of model measurements in wind tunnels. In addition, radar signature measurements of this type could also be envisaged for the future generation of basic data for non-cooperative target identification. This paper serves to discuss the prerequisites for this type of model measurements and to illustrate them with the help of examples. Coherent radar signature measurements on models are carried out at Daimler Benz Aerospace at frequencies of up to a maximum of 110 GHz. This means that the models have to be manufactured with utmost care and that the measuring techniques and set-ups used have to be implemented with the highest precision. This paper presents examples of a series of different aircraft models, discusses the scope of their equipment and the way they are manufactured. Coherent radar signature measurements are subject to special requirements with regard to constancy as measurements for this purpose extend over several hours. The main task consists in compensating influences through induced vibrations, thermal expansion, angular accuracies, of the rotary stand and the phase drift of the measuring equipment. Owing to the extensive measurement range, polarimetric radar signatures are obtained over a wide frequency bands (up to 40 GHz) with a high degree of detail with regard to radar scatter centers. It is shown how such scatter center measurements could be subjected to further processing, permitting the additional assessment of details with regard to their signature properties. Also polarimetric signatures are presented with the help of examples. On the basis of the data obtained, radar signature characteristics can be determined which are distinguishable by aspect angle, frequency polarization and pulse response. In addition, precise scatter center resolution also permits the simulation of stealth measures that might have been implemented on individual components so that also modified radar signatures can be entered into appropriate databases (stealth retrofit). In this way, radar signature measurements on scaled models constitute a valuable means for analyzing also external aircraft types in different equipment conditions.

Author

Radar Measurement; Scale Models; Thermal Expansion; Simulation; Radar Scattering; Aircraft Models

19990018235 British Aerospace Public Ltd. Co., Aerodynamic Technology Dept., Brough, UK

Turbulent Boundary Layer Methods for Supersonic Flow

Cross, A. G. T., British Aerospace Public Ltd. Co., UK; Nov. 1998; 80p; In English; Also announced as 19990018232; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

This paper considers the application of integral boundary layer theory to, turbulent, supersonic flow. Starting from the three-dimensional boundary layer equations the requirements for closure are addressed for the most general case. In particular, closure requires an accurate and consistent treatment of both the temperature and velocity profiles. Further, for supersonic flow the treatment must include an appropriate model for the effects of compressibility. It is shown how a consistent approach to closure can be achieved based on the law of the wall and wake velocity profile. This allows important Reynolds number and pressure gradient effects to be modelled. An important requirement for supersonic flow is the ability to model shock boundary layer interaction. For such flows involving wings the combined effects of Reynolds number and pressure gradient determine the limits and type of separation. Through application involving a viscous Euler calculation method, evidence is provided of the practical use of integral boundary layer methods based on the law of the wall and wake. This use includes application to wing flow involving three-dimensional shock boundary layer interaction.

Author

Turbulent Boundary Layer; Supersonic Flow; Turbulent Flow; Aerodynamics

19990018241 Florida Univ., Graduate Engineering and Research Center, Shalimar, FL USA

Vortex-Plume Interaction Research

Sforza, Pasquale M., Florida Univ., USA; Nov. 1998; 20p; In English; Also announced as 19990018232; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The problem of the wake of an aircraft cruising at supersonic speed in the stratosphere is presented. The two major components of the flow field are the trailing vortex wake and the jet exhaust plumes. Accurate prediction of the dispersion of engine emissions resulting from interaction between the two has important consequences for determination of wake signatures. Research in the field is reviewed to provide an understanding of the present state of the art. Synthesis of these different jet and vortex studies provides a unified global description of aircraft wakes in terms of a length scale bA/Csub L, based on the span, aspect ratio, and cruise lift coefficient. A model is developed in which the jet plumes, being immersed in the trailing vortex wake downwash, are assumed to deform into twin vortices typical of jets in a cross-flow. This permits the development of the wake flow field to be assessed with the relatively simple tools of vortex filament analysis. Wakes of both conventional high subsonic and supersonic

aircraft may be accommodated by this approach, as would the wakes of wing-jet combination injectors for scramjet applications. Experimental studies that would aid in the development of more accurate prediction methods are also described.
Author
Plumes, Vortices, Supersonic Aircraft, Aircraft Wakes, Jet Exhaust, Cruising Flight

19990018248 Florida Univ., Graduate Engineering and Research Center, Shalimar, FL USA
Shock-Vortex Interaction Research
Storza, Pasquale M., Florida Univ., USA; Nov. 1998; 24p; In English; Also announced as 19990018232; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Supersonic cruise aircraft generate shock waves and vortices as a consequence of the flight speed and the forces generated, respectively. Interactions between these two produce flow disturbances which affect aircraft performance, stability and control. Research in the field is reviewed to provide an understanding of the state of the art. The important parameters in the interaction are the Mach number and the swirl to axial velocity ratio of the vortex. The phenomenon of vortex breakdown is described and a criterion for determining if a shock-vortex interaction is strong enough to provoke it is given. Models developed thus far for evaluating such interactions are presented. Experimental investigations of shock-vortex interactions are also discussed.
Author
Shock Wave Interaction, Vortices, Cruising Flight, Supersonic Aircraft, Aerodynamics, Oblique Shock Waves

19990018483 Science Applications International Corp., Wayne, PA USA
Hot Jet and Mach Number Effects on Jet Interaction Upstream Separation
Hudson, Douglas J.; Trolier, James W.; Harris, Thomas B.; Jan. 1998; 13p; In English
Contract(s)/Grant(s): N66001-91-D-0246
Report No.(s): AD-A356665; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Computational fluid dynamics solutions have been performed to evaluate flowfield separation effects resulting from the firing of a divert thruster on a biconic endoatmospheric interceptor. Comparisons are made with cold jet wind tunnel data in order to validate the prediction model which is then applied to hot jet flight conditions at a higher Mach number and momentum flux ratio. Scaling of the wind tunnel results to flight based on momentum flux ratio implies the existence of a large separated region onto the interceptor fore cone. Simulation results for the hot jet, however, showed no separation onto the fore cone. The reasons for these differences are primarily attributed to the higher freestream Mach number and lower specific heat ratio in the hot jet case. Other issues concerning the scaling of cold jet wind tunnel results to flight are also discussed.
DTIC
Computational Fluid Dynamics, Mach Number, Wind Tunnels, Flight Conditions, Flow Distribution, Free Flow

19990018284 Maryland Univ., Dept. of Mechanical Engineering, College Park, MD USA
(NWV-36) Integrated Optimization of Aircraft Subsystems: *Final Report, 1 Mar - 31 Oct. 1998*
Rademacher, Reinhard; Sep. 30, 1998; 68p; In English
Contract(s)/Grant(s): F49620-98-1-0322
Report No.(s): AD-A355901; AFRL-SR-BL-TR-98-0704; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The goal of this project is to demonstrate by using a heat exchanger as an example, that the minimization of life cycle entropy generation is a useful concept for the optimization of thermal systems. For this purpose the entropy production over the life of the heat exchanger is calculated and in addition the entropy generated during the manufacturing process is accounted for too. In this exploratory phase of the project, the entropy generation during the manufacturing process is calculated based only on the entropy production during the various energy conversion processes that contribute to the manufacturing process. This includes the metal processing beginning with the ore and accounting for a fraction of recycled metal that is usually included it also accounts for the contribution of human labor, although this term is found to be usually negligible. A simulation code was written for the heat exchanger to calculate and minimize its life cycle entropy generation. The results clearly show that minima are found when design parameters such as material selection, tube length, number 0 tubes, operating conditions and others are varied. The results also indicate that this method will continue to be useful when applied to more complex systems such as entire subsystems and complete, integrated systems such as aircraft.
DTIC
Aircraft Equipment, Heat Exchangers, Design Analysis, Life (Durability), Entropy

19990018578 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Compressor Load Stand: Commissioning and Control Strategies
Causey, Andrew E.; May 1998; 112p; In English
Report No.(s): AD-A356197; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The purpose of the load stand utilized in this project is to accurately measure the operating characteristics of hermetic compressors, for a range of cooling capacities from 1 ton to 3 tons of refrigeration. The results will be used for comparison to results obtained by a mathematical model developed by Halnus I. In this project a 1 ton, horizontal type, scroll compressor was tested with R-22 as the working fluid. The purpose of this research project was to commission this load stand, which includes setting up the hardware, setting up a control system, a data acquisition system, and an automatic test sequence system. The objective of the control system is to obtain test points that are defined by a compressor suction pressure, suction temperature, and discharge pressure. The data acquisition system should accurately measure the operating points of the compressor to include power consumption W, mass flow rate KG/H, and discharge temperature 0 C. These results can then be used to produce a compressor map, verify existing compressor maps, or verify the results obtained from a compressor model. The purpose of the automatic test sequence system is to provide a system that will run the load stand through test conditions without the need for human interactions. This report is not only a research report but also serves as a user S manual for the load stand. It will provide the user with a working knowledge of the load stand and documentation for the software used to operate, control, and modify the load stand systems. The report will include descriptions of the cycle utilized, the system hardware, the data acquisition system, the control strategy and hardware utilized, the operating characteristics of the system, and the automatic test sequence system. It will also provide information useful for changing the system when needed and to run the system effectively.
DTIC
Computer Programs; Data Acquisition; Compressors; Hermetic Seals; Refrigerating; Working Fluids; Cooling

19990018837 Case Western Reserve Univ., Cleveland, OH USA
Rotordynamics and Design Methods of an Oil-Free Turbocharger
Howard, Samuel A., Case Western Reserve Univ., USA; January 1999; 15p; In English; Sponsored in part by Timken Foundation
Contract(s)/Grant(s): NCC3-408; RTOP 523-22-13
Report No.(s): NASA/CR-1999-208689; E-11476; NAS 1.26:208689; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The feasibility of supporting a turbocharger rotor on air foil bearings is investigated based upon predicted rotordynamic stability, load accommodations, and stress considerations. It is demonstrated that foil bearings offer a plausible replacement for oil-lubricated bearings in diesel truck turbochargers. Also, two different rotor configurations are analyzed and the design is chosen which best optimizes the desired performance characteristics. The method of designing machinery for foil bearing use and the assumptions made are discussed.
Author
Foil Bearings; Turbocompressors; Rotor Dynamics; Superchargers; Design Analysis; Gas Bearings

19990019021 National Aerospace Lab., Amsterdam Netherlands
Uniaxial and Biaxial Tests on Riveted Fuselage Lap Joint Specimens
Oct. 1998; 56p; In English
Report No.(s): AD-A357973; NRL-CR-97319L; DOT/FAA/AR-98/33; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

As a part of a collaboration program between the Federal Aviation Administration (FAA, USA) and the Department of Civil Aviation (RLD, the Netherlands), the Dutch National Aerospace Laboratory (NLR) has carried out fatigue tests on riveted lap joint specimens. The specimens are representative of the longitudinal lap joints of a commercial aircraft in which multiple-site damage (MSD) was found in service. Two different rivet configurations, dimpled and countersunk riveted joints, were investigated. The countersunk riveted specimens were bonded as well. Four different bonding qualities ranging from fully bonded to fully unbonded were tested. The results of the test program showed that the fatigue life until failure of the dimpled lap joint specimens was about one-quarter of that of the unbonded countersunk specimens. The bonding quality is a major parameter for the fatigue life. Fully or partly bonded specimens did not show fatigue cracking within 500 or even 1000 Lifecycles. Specimens with a fully degraded bonding layer have slightly better fatigue properties compared to fully unbonded specimens.
DTIC
Bonding; Civil Aviation; Commercial Aircraft; Damage; Defects; Failure; Fatigue Life; Fatigue Tests

14
LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and space biology.

19990018336 Defence and Civil Inst. of Environmental Medicine, Toronto, Ontario Canada
An Exploratory Application of Ecological Interface Design to Aircraft Systems
Beevis, D., Defence and Civil Inst. of Environmental Medicine, Canada; Vicente, K., Toronto Univ., Canada; Dinadis, N., Toronto Univ., Canada; Dec. 1998; 10p; In English; Also announced as 19990018334; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Ecological interface design (EID) is a theoretical framework for designing Operator-Machine Interfaces (OMIs) that tries to integrate different kinds of representations into a common interface based on two concepts from cognitive engineering: (1) the abstraction hierarchy; and (2) the skills, rules, and knowledge framework. The abstraction hierarchy is a multilevel knowledge structure that can be used to develop physical and and functional models of systems as well as the mappings between them. The skills, rules, knowledge framework provides principles for information to support those three levels of behaviour. to date, most applications of EID have been to process control. In order to explore the applicability of EID to aircraft systems and to build on previous work, an exploratory application was made to the systems of the CC-130 Hercules aircraft which are controlled by the Flight Engineer (FE). The project included: (1) in-flight familiarization; (2) a protocol analysis of FE tasks; (3) preparation of an abstraction hierarchy of the CC-130 systems; (4) definition of the interface content and structure; and (5) representation of the information in visual form. The outcome was a rapid prototype of an 'EID interface' for the CC-130 engineering systems that was evaluated by a focus group of Canadian Forces Flight Engineers. The study concluded that: (1) the principles of EID can be applied to aircraft systems; (2) EID needs to be supplemented by more specific design principles; and (3) EID can be integrated with such principles. Operator response to the prototype showed that the design of the OMI for one operator needs to take into account the responsibilities and functions of other crew members.
Derived from text
Design Analysis; Flight Control; Protocol (Computers); Interfaces; Aircraft Design

19990018342 British Aerospace Public Ltd. Co., Sowerby Research Centre, Filton, UK
Multi-Crew Workload Measurement for Nimrod MRA4
Harmer, Steven, British Aerospace Public Ltd. Co., UK; Dec. 1998; 6p; In English; Also announced as 19990018334; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

British Aerospace as Prime Contractor for the UK's Replacement Maritime Patrol Aircraft, the Nimrod MRA4, due to enter service at the beginning of the next century, is required to demonstrate that the crew workload levels associated with operating the aircraft do not exceed acceptable levels. In order to do this BAe must be able to define this acceptance level and provide a meaningful mechanism for measuring workload in a multi-crew environment, where environment, where task allocation is highly dynamic and team working is essential. This paper describes the techniques, the method proposed for comparing between two different crew compositions and the issues associated with deriving crew workload acceptance criteria.
Author
Workloads (Psychophysiology); Crews; Reconnaissance Aircraft

19990018343 Air Force Research Lab., Collaborative Systems Technology Branch, Wright-Patterson AFB, OH USA
Assessing Operators' Potential for Collaboration in Complex Systems
King, R. E., Air Force Research Lab., USA; Callister, J. D., Armstrong Lab., USA; Retzlaff, P. D., University of Northern Colorado, USA; Dec. 1998; 4p; In English; Also announced as 19990018334; Copyright Waived; Avail: CASI; A01, Hardcopy; A04, Microfiche

The operators of the future will face an ever-changing enemy. As nation-states and political systems rise and fall so will the nature of warfare and war machines. The cognitive abilities and personality make-up of combatants may need to change with both the enemy and technology. Pilotless aircraft and advanced spacecraft lend unique challenges to the psyche of the operator, as does rapid change from localized flare-ups to global nuclear threats. Experts in psychological research will be tasked to help aviators and policy makers keep the operator up with the rapid changes. As we invest increasingly large amounts of money into each individual airframe and mission, we must learn more about the human operator, whether that individual is a pilot or an operator in a virtual reality environment. ALAPS may aid selection of tomorrow's aviators, as it is an aviation-specific personality inventory.

We plan to establish real-world, criterion validity by correlating findings on the ALAPS to behavioral measures, such as simulator flights, peer evaluations, and flight performance reports on mission-tested aviators.
Derived from text
Mental Performance; Virtual Reality; Pilotless Aircraft; Flight Characteristics; Complex Systems; Aircraft Pilots

19990018347 Institute of Aviation Medicine, Prague, Czechoslovakia
Physiological Parameters as a Possible Information About Collaboration Between Two Crew of the Commercial Aircraft During Long Haul Flights
Truska, Oldrich, Institute of Aviation Medicine, Czechoslovakia; Suic, Jiri, Institute of Aviation Medicine, Czechoslovakia; Dec. 1998; 8p; In English; Also announced as 19990018334; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

By comparison of psycho-physiological response of a crew, consisting of two unequally experienced pilots it followed that the individuals with lesser amount of total and type specific flying hours than their counterparts are exposed to higher workload, regardless of their actual position within the crew. The cardiovascular response to the medium- and long-haul flights was more intense in flight officers than in commanders. The same difference appeared in subjective feeling of fatigue.
Author
Workloads (Psychophysiology); Physiological Responses; Commercial Aircraft; Cardiovascular System; Human Performance

19990018353 Abertay Univ., Div. of Psychology, Dundee, UK
Communication Requirements in the Cockpit
Cook, Malcolm J., Abertay Univ., UK; Elder, L., Abertay Univ., UK; Ward, George, ESE Associates, UK; Dec. 1998; 12p; In English; Also announced as 19990018334; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents evidence in support of the view that communication requires careful assessment, and the introduction of new technologies must be carefully assessed to address the changes they may produce in communication patterns. One of the reasons why communication is more likely to be subject to changes in systems in multi-crew multi-platform or multi-crew single platform systems is the role of sensitivity of collaborative systems to dis-engagement. In simple terms it has been recognized that collaborative applications and systems require multiple users if they are going to be successful. If users feel that the communication tasks interfere with other functions or are difficult to use then multi-user systems will fail.
Derived from text
Cockpits; Communication; Human Performance; Workloads (Psychophysiology)

19990018356 Defence Evaluation Research Agency, Centre for Human Sciences, Farnborough, UK
The Human-Electronic Crew: Human-Computer Collaborative Teamworking
Taylor, R. M., Defence Evaluation Research Agency, UK; Reising, J., Air Force Research Lab., USA; Dec. 1998; 18p; In English; Also announced as 19990018334; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Advances in artificial intelligence will enable future military aircraft to have a rather unique crew - one human and electronic. It has proved useful to consider the required relationship as a Human-Electronic Crew team, involving collaborative, co-operative working between the human and the machine. This team is led by the pilot, with the Electronic Crewmember as a subordinate associate or assistant sharing responsibility, authority and autonomy over many cockpit tasks. As aircraft systems become more complex, the automation that the aircraft pilot has to interact with is becoming increasingly intelligent and capable. The pilot needs to remain in control of the system in uncertain situations with unpredictable demands, and yet make full use of the aiding that is provided, while being flexible and adaptive. The requirements for useful, intelligent aiding, in a highly dynamic task environment has led to impressive technical achievements. These include methods for in-flight situation assessment and replanning, cognitive modelling, human intent inferencing and error recognition, and the use of complex knowledge engineering and reasoning logic processes. Providing an appropriate architecture for complex system functioning, where the pilot can trust the Electronic Crewmember with autonomous aiding, but that keeps the pilot in control, presents a continuing engineering challenge.
Author
Human-Computer Interface; Knowledge Representation; Expert Systems; Crews; Aircraft Pilots; Artificial Intelligence

19990018574 Joint Publications Research Service, Arlington, VA USA
Sopite Syndrome in Operational Flight Training
Flaherty, David E.; Sep. 1998; 88p; In English
Report No.(s): AD-A354942; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Sopite Syndrome is a poorly understood response to motion characterized by drowsiness, fatigue, sleep disturbances, and mood changes. It is distinct from "regular" motion sickness or common fatigue, and may affect the performance of motor vehicle as well as aircraft operators. The potential impact Sopite Syndrome may have on military aviation is relatively unknown. Recently, research in situations relevant to aviation training and flight operations has been initiated. The present study is part of that effort. Its goal is to determine the incidence, severity, and association of Sopite Syndrome characteristics in a population of Student Naval Flight Officers (SNFOs). Seventy-eight SNFOs assigned to Training Squadrons Four and Ten located at the Naval Air Station Pensacola, Florida completed a questionnaire designed to capture evidence/incidence of fatigue, motion sickness, drowsiness, and sleep disturbances during days when SNFOs flew versus non-flying days. The questionnaire data was coded/tabulated for entry on a spreadsheet for subsequent analysis. Descriptive and non-parametric statistical techniques were used to analyze the data set obtained. The results show sufficient evidence between the levels of symptomology and their relationships when comparing conditions that support the existence of Sopite Syndrome in operational flight training.
DTIC
Flight Training; Motion Sickness; Signs and Symptoms; Aircraft Pilots; Symptomology

19990018860 Defence and Civil Inst. of Environmental Medicine, Downsview, Ontario Canada
Results of continued Freefall Helmet Impact Studies
Adam, J.; Apr. 06, 1998; 34p; In English
Report No.(s): AD-A356685; 98-TM-55; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A new sample foam insert for the Protec helmet was impact tested along with a standard insert to determine differences in impact protection. This testing was performed to ascertain the suitability of the new protective insert in the role of freefall parachute helmet. The testing showed that the performance of the new insert was better than the standard insert, but did not meet the standards set prior to testing. 1. There is a continuing requirement for a protective helmet for Freefall Parachuting within the Canadian Forces. The impact protection of candidate helmets to be used in the freefall parachute role has been identified as a major concern. As such, the Defence and Civil Institute of Environmental Medicine (DCIEM) was tasked by Director Land Requirements (DLR) to perform impact testing on a new foam liner insert for the candidate helmet (Protec). This testing was to be performed as a continuation of the previous work (Ref A). 2. The aim of this project was to measure and analyse the impact performance of a new foam insert for the Protec helmet. Comparison to the original foam insert was to be made, along with performance relative to the standards described below.
DTIC
Impact Tests; Parachutes; Protection; Helmets

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MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

19990018024 NASA Lewis Research Center, Cleveland, OH USA
Visual Computing Environment Workshop
Lawrence, Charles, Compiler, NASA Lewis Research Center, USA; Nov. 1998; 76p; In English, 6 Nov. 1997, Cleveland, OH, USA, Sponsored by NASA Lewis Research Center, USA
Contract(s)/Grant(s): RTOP 509-10-31
Report No.(s): NASA/CP-1998-208525; NAS 1.55:208525; E-11279; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The Visual Computing Environment (VCE) is a framework for intercomponent and multidisciplinary computational simulations. Many current engineering analysis codes simulate various aspects of aircraft engine operation. For example, existing computational fluid dynamics (CFD) codes can model the airflow through individual engine components such as the inlet, compressor, combustor, turbine, or nozzle. Currently, these codes are run in isolation, making intercomponent and complete system simulations very difficult to perform. In addition, management and utilization of these engineering codes for coupled component simulations is a complex, laborious task, requiring substantial experience and effort, to facilitate multicomponent aircraft engine analysis, the CFD Research Corporation (CFDRC) is developing the VCE system. This system, which is part of NASA's Numeri-

cal Propulsion Simulation System (NPSS) program, can couple various engineering disciplines, such as CFD, structural analysis, and thermal analysis.
Author
Aircraft Engines; Computational Fluid Dynamics; Air Flow; Thermal Analysis; Propulsion; Software Development Tools

19990018064 Elektroniksystem- und Logistik G.m.b.H., Experimental Avionics Systems, Munich, Germany
Crew Assistance for Tactical Flight Missions in Simulator and Flight Trials
Schulte, Axel, Elektroniksystem- und Logistik G.m.b.H., Germany; Kloeckner, Wolfgang, Elektroniksystem- und Logistik G.m.b.H., Germany; Nov. 1998; 10p; In English; Also announced as 19990018045; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

This paper describes an approach to technical crew assistance for tactical low-level flight missions. The relevant tasks are combined under the term mission management. In the first part of the contribution the chain of functions required for crew support in tactical mission management tasks is briefly summarised. As the tactical mission management system is a major part of the Crew Assistant Military Aircraft (CAMA), its integration into the context of a cognitive assistant system is the subject of the second part of this paper. The modules of the tactical mission management system represent the methodological approaches and implemented functions of CAMA which are related to tactical operations. A selection of pure tactical mission management functions and the fully integrated CAMA system recently underwent critical evaluation experimentation. Major parts of the tactical mission management system were tested in a flight trial campaign. CAMA was thoroughly evaluated in a series of simulator flights with operational personnel. The approach and relevant results for both activities are presented in the third part of this paper. Finally, the conclusions and a view of future prospects are presented for tactical mission management assistance and the related research and technology programmes. CAMA will prove the maturity of its methods in forthcoming flight trials in which sensor integration issues will also be addressed.
Author
Flight Simulators; Flight Crews; Man Machine Systems; Human-Computer Interface; Decision Support Systems; Expert Systems; Pilot Support Systems; Flight Management Systems

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PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy; optics; plasma physics; solid state physics; and thermodynamics and statistical physics.

19990017839 ANSER Corp., Arlington, VA USA
Aero-Optic and Aerothermal Performance of Externally Cooled Infrared Window at Hypersonic Flight Conditions
Sutton, George W., ANSER Corp., USA; Pond, John E., Analysis and Applications Associates, Inc., USA; Nov. 1998; 10p; In English; Also announced as 19990017801; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The results of aero-optics calculations and experiments are presented and compared, for a generic 3D shape of missile forecone with external optical window cooling. The flow field and turbulent flow over the window cause a line-of-sight error and blurring of an image of an imaging optical sensor (IOS). A description of the equations and methodology are presented for predicting these effects. Both time average and instantaneous blur circles are presented. The results compare favorably with experiments.
Author
Infrared Windows; Optical Measuring Instruments; Missiles; Aerodynamic Heating; Hypersonic Flight; Cooling; Turbulent Flow

19990018027 NASA Lewis Research Center, Cleveland, OH USA
Design Selection and Analysis of a Swept and Leaned Stator Concept
Envia, Edmane, NASA Lewis Research Center, USA; Nallasamy, M., NYMA, Inc., USA; Dec. 1998; 22p; In English
Contract(s)/Grant(s): RTOP 538-03-11
Report No.(s): NASA/TM-1998-208662; NAS 1.15:208662; E-11383; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes a theoretical design and analysis study of the benefits of vane sweep and lean for reducing rotor- stator interaction tone noise. It is shown that the kinematic relationship between the rotor wakes and stator vanes is the principal factor in determining the achievable noise reductions. Vane sweep and lean control rotor wake skewing as seen by the stator vanes and hence influence the number of wake intersections per vane. An increase in the number of intersections reduces noise levels. Hence,

to reduce rotor-stator noise, van sweep and lean must be chosen in such a way as to increase wake intersections per vane. A simple design rule is thus proposed which requires a sweep configuration that puts the vane tip downstream of its root and a vane lean that is in the direction of the rotor rotation. A detailed comparison of the predicted and measured noise reductions for a swept and leaned stator is then carried out. Overall, these comparisons show that the predicted benefits of a swept and leaned stator are in good agreement, qualitative as well as quantitative, with the measured reductions for the fan speeds relevant to noise certification procedure. Furthermore, the results also demonstrate the validity of design criterion and the theoretical tools used in this study. Author

Acoustics; Aerodynamic Noise; Rotors; Design Analysis; Vanes

19990018229 Systemtechnik Nord G.m.b.H., Land and Airborne Systems Div., Bremen, Germany

Non-Cooperative Helicopter Detection by Acoustical Sensors

Becker, Gunnar R., Systemtechnik Nord G.m.b.H., Germany; Nov. 1998; 8p; In English; Also announced as 19990018200

Contract(s)/Grant(s): BRVg-Ru-IV/4; BWB-FE-IV/6; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

This paper discusses the potential of acoustic sensors and arrays for non-cooperative air target detection. Acoustic sensors, i.e. microphones, are passive and make use of the sound emitted by the targets themselves. It is shown that acoustic systems can provide valuable information such as detection, tracking and classification of air targets. The paper mainly focuses on low flying combat helicopters, because they are difficult to detect by other means. It turns out that Radar and acoustics are sensors with complementary performance.

Author

Helicopters; Target Acquisition; Aircraft Detection; Detection

19990018238 Colorado Univ., Boulder, CO USA

Sonic Boom Minimization

Seebass, Richard, Colorado Univ., USA; Woodhull, John R., Colorado Univ., USA; Nov. 1998; 14p; In English; Also announced as 19990018232; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

We revisit the classical Jones-Seebass-George-Darden theory of sonic boom minimization, noting that minimum achievable sonic boom is related to the aircraft's weight divided by the three-halves power of its length. We then summarize studies of sonic boom acceptability and the effects of vibrational relaxation on very weak shock waves. This leads us to conclude that a small, appropriately designed, supersonic business jet's sonic boom may be nearly inaudible outdoors and hardly discernible indoors. It is important to note at the outset that any improvement in the traditional parameters that govern the efficiency of the aircraft that result in a reduction of the aircraft's weight also provide, thereby, a reduction in sonic boom overpressure and impulse. Improvements in the lift-to-drag ratio, the thrust-to-weight ratio, the specific fuel consumption and the structural efficiency can all result in sonic boom reductions for an aircraft with the same range. Conversely, aerodynamic changes that appear to reduce the sonic boom but that compromise any of these traditional figures of merit will probably increase the sonic boom. One of the primary difficulties in this field has been knowing what is to be reduced or minimized in order to make the sonic boom acceptable. Here we know much more than we did twenty-five years ago. As it is experienced outdoors, the most annoying feature of the sonic boom is the shock wave that gives rise to the more descriptive appellation used in Europe, "sonic bang." For small aircraft this may be the principal parameter for sonic boom annoyance and loudness, indoors or outdoors. For large aircraft, when the sonic boom is experienced indoors, another significant parameter is undoubtedly the energy in the signature as a function of frequency, perhaps adequately characterized by the overpressure and the impulse of the signature. The impulse is the integral of the pressure with time over that period of time during which the pressure is positive. For commercial transport-size aircraft the impulse is also a significant parameter in studies of structural disturbances due to, and the indoor loudness and annoyance from, sonic booms. Author

Sonic Booms; Optimization; Supersonic Jet Flow; Transport Aircraft; Noise Reduction; Aerodynamic Noise; Jet Aircraft Noise

19990018582 Virginia Polytechnic Inst. and State Univ., Blacksburg, VA USA

Active Control of Radiated Sound With Integrated Piezoelectric Composite Structures, Volume 3: Appendices (Cont.) *Final Report, 15 Sep. 1994 - 31 Mar. 1998*

Fuller, Christopher R.; Cross, L. E.; Nov. 06, 1998; 288p; In English; Prepared in cooperation with The Pennsylvania State Univ., Philadelphia. ADA356904 ADA356905

Contract(s)/Grant(s): N00014-94-1-1140

Report No.(s): AD-A356903; No Copyright; Avail: CASI; A13, Hardcopy; A03, Microfiche

The report describes work by MRL-PSU on developing an constructing a new actuator called PANEL based upon using double amplification obtained from a system of orthogonal bimorph piezoelectric elements covered with an acoustic diaphragm

configured in a flextensional type manner. The resultant PANEL source after many iterations of analysis, development, construction and testing was found to provide amplification ratios of around 250:1 and generate diaphragm vibration levels of the order of 500 microns (on resonance) and 200 microns (off resonance) over a frequency range of o to 1500Hz. The corresponding sound pressure levels generated by the PANEL source at im ranged from 80dB at 200Hz to 90dB above 400Hz. These performance levels were considered high enough to enable the PANEL source to be applied to a number of practical noise problems such as interior noise in aircraft and cars as well as electrical transformer noise and jet engine inlet noise. For applications below 200Hz, where the performance of the PANEL falls off, a new pseudo-shear multi-layer actuator utilizing folded multi-layer piezoelectric elements was developed and tested. The new pseudo-shear actuator was found to have significantly enhanced very low frequency performance below 200Hz. The report also describes the new active noise control approach based upon implementing an active-skin which completely covers the structure conceived by VAL-VPI. In the VAL part of the project, multiple PANEL actuators were integrated into a continuous skin system with independently controllable sections.
DTIC
Composite Structures; Active Control; Aircraft Noise; Piezoelectricity

19990018583 Virginia Polytechnic Inst. and State Univ., Blacksburg, VA USA
Active Control of Radiated Sound With Integrated Piezoelectric Composite Structures, Volume 3 Appendices (Concl.) *Final Report, 15 Sep. 1994 - 31 Mar. 1998*
Fuller, Christopher R.; Cross, L. E.; Nov. 06, 1998; 300p; In English; Prepared in cooperation with The Pennsylvania State Univ., Philadelphia. ADA356903 ADA356905
Contract(s)/Grant(s): N00014-94-1-1140
Report No.(s): AD-A356904; No Copyright; Avail: CASI; A13, Hardcopy; A03, Microfiche

The report describes work by MRL-PSU on developing an constructing a new actuator called PANEL based upon using double amplification obtained from a system of orthogonal bimorph piezoelectric elements covered with an acoustic diaphragm configured ir flextensional type manner. The resultant PANEL source after many iterations of analysis, development, construction and testing was found to provide amplification ratios of around 250:1 and generate diaphragm vibration levels of the order of 500 microns (on resonance) and 200 microns (off resonance) over a frequency range of o to 1500Hz. The corresponding sound pressure levels generated by the PANEL source at im ranged from 80dB at 200Hz to 90dB above 400Hz. These performance levels were considered high enough to enable the PANEL source to be applied to a number of practical noise problems such as interior noise in aircraft and cars as well as electrical transformer noise and jet engine inlet noise. For applications below 200Hz, where the performance of the PANEL falls off, a new pseudo-shear multi-layer actuator utilizing folded multi-layer piezoelectric elements was developed and tested. The new pseudo- shear actuator was found to have significantly enhanced very low frequency performance below 200Hz. The report also describes the new active noise control approach based upon implementing an active-skin which completely covers the structure conceived by VAL- VPI. In the VAL part of the project, multiple PANEL actuators were integrated into a continuous skin system with independently controllable sections.
DTIC
Composite Structures; Aircraft Noise; Active Control; Resonant Frequencies; Piezoelectricity; Noise Reduction; Engine Inlets

19990018584 Virginia Polytechnic Inst. and State Univ., Blacksburg, VA USA
Active Control of Radiated Sound with Integrated Piezoelectric Composite Structures, Volume 1 *Final Report, 15 Sep. 1994 - 31 Mar. 1998*
Fuller, Christopher R.; Cross, L. E.; Nov. 06, 1998; 49p; In English; Prepared in cooperation with The Pennsylvania State Univ., Philadelphia. ADA356903 ADA356904
Contract(s)/Grant(s): N00014-94-1-1140
Report No.(s): AD-A356905; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The report describes work by MRL-PSU on developing an constructing a new actuator called PANEL based upon using double amplification obtained from a system of orthogonal bimorph piezoelectric elements covered with an acoustic diaphragm configured in a flextensional type manner. The resultant PANEL source after many iterations of analysis, development, construction and testing was found to provide amplification ratios of around 250:1 and generate diaphragm vibration levels of the order of 500 microns (on resonance) and 200 microns (off resonance) over a frequency range of o to 1500Hz. The corresponding sound pressure levels generated by the PANEL source at im ranged from 80dB at 200Hz to 90dB above 400Hz. These performance levels were considered high enough to enable the PANEL source to be applied to a number of practical noise problems such as interior noise in aircraft and cars as well as electrical transformer noise and jet engine inlet noise. For applications below 200Hz, where the performance of the PANEL falls off, a new pseudo-shear multi-layer actuator utilizing folded multi-layer piezoelectric elements was developed and tested. The new pseudo- shear actuator was found to have significantly enhanced very low frequency

performance below 200Hz. The report also describes the new active noise control approach based upon implementing an active-skin which completely covers the structure conceived by VAL- VPI. In the VAL part of the project, multiple PANEL actuators were integrated into a continuous skin system with independently controllable sections.
DTIC
Composite Structures; Aircraft Noise; Noise Reduction; Resonant Frequencies; Active Control; Piezoelectricity

17
SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

19990018692 Virginia Univ., School of Engineering and Applied Science, Charlottesville, VA USA
Timeliness and Predictability in Real-Time Database Systems *Final Report, 1 Jul. 1994 - 30 Sep. 1998*
Son, Sang H.; Oct. 1998; 12p; In English
Contract(s)/Grant(s): N00014-94-1-0660
Report No.(s): AD-A356510; UVA/525491/CS99/101; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The confluence of computers, communications, and databases is quickly creating a globally distributed database where many applications require real time access to both temporally accurate and multimedia data. This is particularly true in military and intelligence applications, but these required features are needed in many commercial applications as well. Major applications are military command and control, avionics and weapon systems, and monitoring and decision support systems. Those applications have at their core requirements for managing and analyzing massive amounts of data residing in many data repositories. Much of this data has timing attributes such as a particular satellite image being valid for no more than 5 minutes. Audio, video and images are key types of data which provide increased value to applications, but also increased challenges. Driving such systems are significant real time requirements for managing thoUSAnds of objects and tracking them by using a global, intelligent, and responsive multimedia database system. The objective of this project was to develop new database system technology for distributed real time systems and to evaluate them in the experimental real time database servers. Our focus has been to discover a set of design principles for building dependable and responsive database systems for time critical applications and to develop algorithms to improve timeliness and predictability of such systems.
DTIC
Data Bases; Data Management; Real Time Operation; Design Analysis; Time Dependence; Computers; Algorithms; Avionics

Subject Term Index

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